JULY, 1960
No. 247

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American Society for Testing Materials

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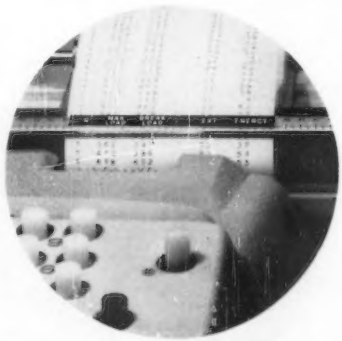

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ASTM BULLETIN

July 1960 **Number 247**

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TECHNICAL PAPERS

Measurements of Human Reaction to Hardness of Floor Coverings—R. Schjödt. *Electromyography is used to record the work done by leg muscles in subjects walking on various floor coverings. Results are compared with hardness and indentation tests, and a relative "hardness" scale for floor surfaces is proposed*..... 53

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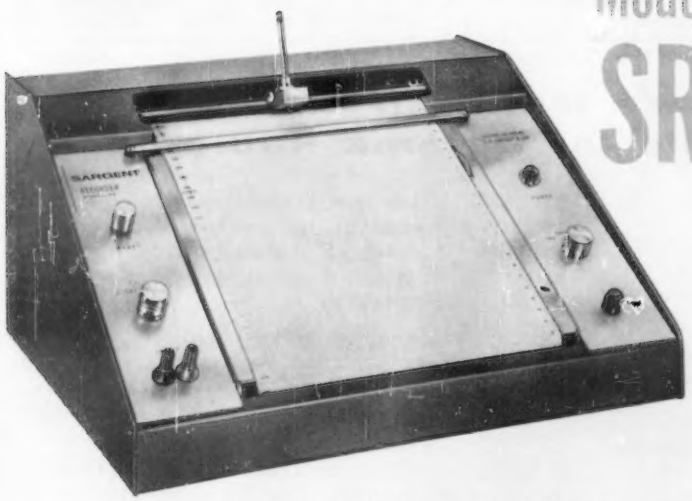

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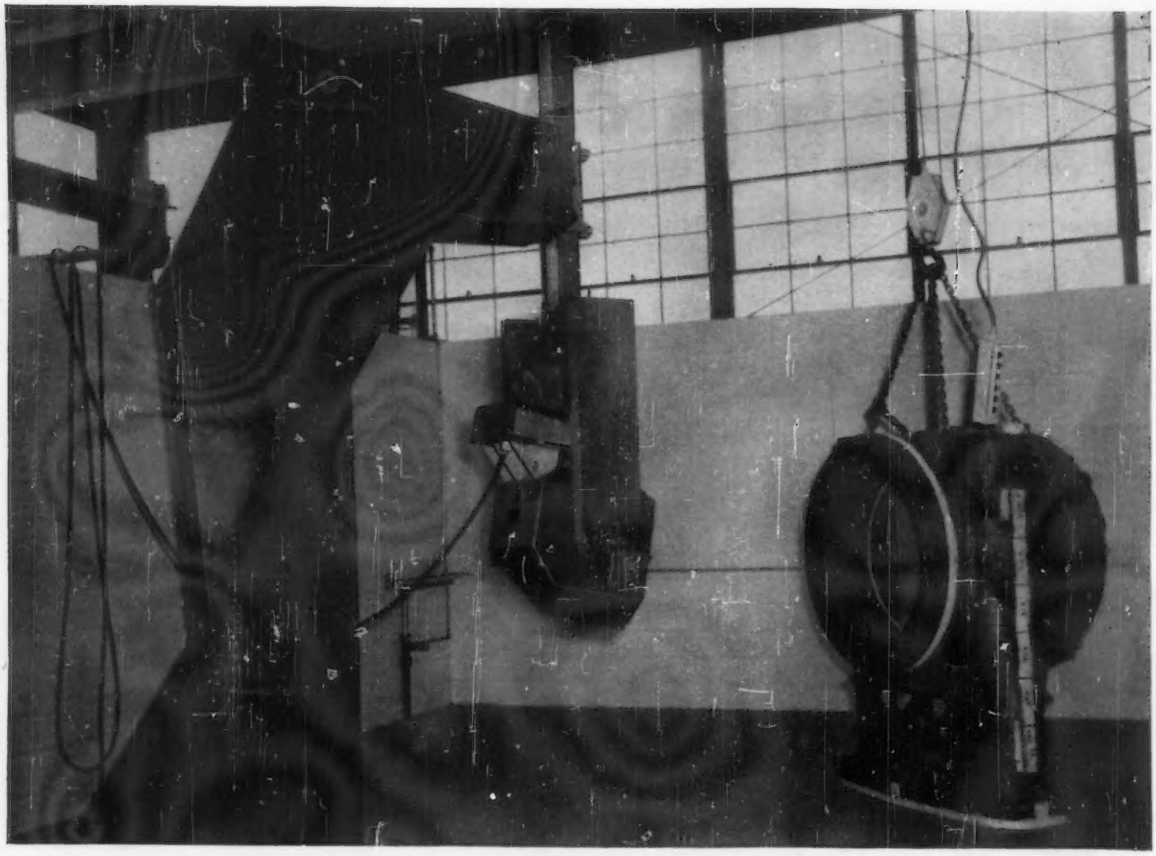

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ASTM BULLETIN

Research and Standards for Materials

Number 247 July 1960

63rd ASTM Annual Meeting

- Materials Sciences
- Solar Energy
- Nuclear Fuel Elements
- International Aspects of ASTM
- Apparatus Exhibit
- New Standards for Industry
- Election of Officers
- Honors and Awards

WHILE THE bread-and-butter work of the Society—creation of materials specifications and test methods—was being pressed forward vigorously by the technical committees, a concurrent program of technical sessions and symposia was helping to make another jam-packed week for the ASTM, in Atlantic City, N. J., the last week in June.

Registration for the week, 3339, again broke all records for an ASTM national meeting. Ladies registration reached a total of 449.

Materials Sciences

Recent progress in materials sciences and the nature and origin of strength of materials were thoroughly explored in nine papers presented in the first two symposia sponsored by the new Division of Materials Sciences. Solid-state theory, properties of semiconductors, ductile ceramics, dislocations, and the mechanisms of creep and fracture were among the topics discussed.

Both of these symposia attracted capacity audiences, and the Materials Sciences Luncheon was sold out in advance.

Solar Energy

In his 1960 Marburg Lecture, Farrington Daniels, University of Wisconsin, considered the abundance and limitations of solar energy and reviewed present-day research in that field, with emphasis on the new materials that will be necessary in the successful application of solar energy: plastics for reflectors and covers for solar-energy collectors, silicon for solar cells, solid-state devices for thermoelectric and thermionic energy converters, and selective coatings for high-efficiency energy absorbers.

Nuclear Fuel Elements

In his Gillett Memorial Lecture, R. Carson Dalzell, U. S. Atomic Energy Commission, discussed one of the most difficult problems facing the designer of nuclear reactors—standardization of fuel elements. Dr. Dalzell outlined the scientific, engineering, and economic problems that are important in this developing industry, reviewed the present state of research and development, and summarized the opportunities and prospects for standardization.

International Aspects of ASTM

Technical assistance to underdeveloped countries, in the form of ASTM standards, would provide a wealth of information on materials not available in any other form, and would

S.R.O.

The first two symposia sponsored by the new Materials Sciences Division played to a packed house all day Monday. Shown is part of the capacity crowd attending the morning session on "Recent Progress in Materials Sciences."

63rd Annual Meeting

R. C. Dalzell delivers the Gillett Lecture on "Nuclear Fuel Element Development."

be a sure way to put international trade in materials on a sound base. These points were made by F. L. LaQue in his retiring-president's address.

In outlining the already international scope of ASTM, Mr. LaQue, who is vice-president and manager, Development and Research Div., The International Nickel Co., Inc., cited as evidence the facts that the Society now has members in more than 50 foreign countries; that in 1959 it received more than 9000 orders for publications from more than 65 foreign countries, from Afghanistan to the Windward Islands; that for some time it has been making substantial contributions to the work of the International Standards Organization, through the American Standards Assn.

"Our government is committed to a policy of providing technical assistance to other countries, and particularly to what are called 'underdeveloped' countries," said Mr. LaQue. "In the field of materials, the 14,359 pages in the ten volumes of ASTM standards comprise the greatest concentration of immediately and practically usable information that it would be possible to furnish anyone needing such data . . . In most cases, no further work or search for data should be required to characterize a material needed for some specific purpose, whether it be concrete for a wall, steel for a bridge, or fuel for an engine." The complete text of Mr. LaQue's address begins on page 7.

New Standards for Industry

More than 900 meetings were held of the technical committees and subgroups whose task it is to keep ASTM standards up to date and to create new ones as needed by industry. A list of the new tentatives and standards approved at the Annual Meeting appears on page 31. A more complete account of the committee activities will appear in the September issue of the BULLETIN.

Marburg Lecturer Farrington Daniels speaks on "Solar Energy."

Exhibits

At the 14th exhibit of testing and scientific apparatus and laboratory supplies, the latest in research and testing apparatus was displayed by the country's leading manufacturers. Hundreds of items ranging from small, hand-manipulated instruments and electronic control devices through high-temperature ovens and heating elements to giant universal testing machines were exhibited by 46 manufacturers.

Materials processing, testing, and research was the theme of the 12th technical photographic exhibit. More than 200 entries were displayed, featuring apparatus, instruments, processing techniques, testing, materials structure, and related topics.

New National Officers; Honors and Awards

Biographical information on incoming President A. Allan Bates and Vice-President R. W. Seniff appears on page 18. Newly elected members of the Board of Directors are introduced on pages 19 and 20. Recipients of a number of special awards honoring members of the Society and information about their contributions to ASTM appear on following pages.

W. O. Baker addresses the Materials Sciences Luncheon on Monday.

HEAD TABLE GUESTS, MATERIALS SCIENCES LUNCHEON

Left to right: Allan L. Tarr, metallurgist, Headquarters, Department of the Army; Col. Paul M. Butman, assistant for applied research, Air Research and Development Command, United States Air Force; Col. H. J. Skidmore, director, U. S. Army Engineer Research and Development Laboratories, Fort Belvoir, Va.; Ira H. Abbott, director of advanced research programs, National Aeronautics and Space Administration; W. O. Baker, principal speaker, vice-president of research, Bell Telephone Laboratories, Inc.; ASTM President F. L. LaQue, vice-president and manager, Development and Research Div., The International Nickel Co., Inc.; J. R. Townsend, special assistant, Office of Defense Research and Engineering, Department of Defense, and past-president of ASTM; J. F. Flagg, manager, Materials Engineering Laboratory, General Electric Co.; S. B. Levin, director of Exploratory Research Division "E," U. S. Army Signal Research and Development Laboratory, Fort Monmouth, N. J.; R. M. Robertson, assistant director for mathematical, physical, and engineering sciences, National Science Foundation; and Peter Kosting, director, Metallurgical Sciences Div., Office of Ordnance Research, U. S. Army; Duke Univ.

International Aspects of ASTM

By F. L. LaQUE*

Broader use of ASTM standards in international trade would be beneficial to all concerned.

IN DEALING with some international aspects of ASTM, it is difficult to resist the temptation to describe such activities by numerous references to statistical data.

For example, we have over 1400 members from over 50 foreign countries. Our income from sales of our publications abroad amounted to over $200,000 in 1959. This resulted from over 9000 orders from 65 countries ranging alphabetically from Afghanistan to the Windward Islands.

In collaboration with the American Standards Assn. we have contributed substantially to the work of the International Standards Organization. Several technical committees cooperate continually with corresponding technical organizations elsewhere in the world, for example, the activities of Committee D-2 on Petroleum Products and Lubricants in collaboration with the Institute of Petroleum (London).

Numerous other examples with supporting statistical data could be cited, but since information of this sort tends to be about as dull as it is impressive, I shall assume that such documentation is unnecessary in this instance. I feel that most people recognize that ASTM operates in a most substantial way on an international scale and occupies a most important position among societies having an international scope.

Any who may seek more detailed support of the statements just made can secure a more than ample documentation by communication with the Staff, or they can get in touch with me directly, since the Staff has furnished me with an abundance of statistical information and examples of international activities for possible use in composing these remarks.

I have suggested to the Headquarters Staff that they prepare a general account of ASTM activities on an international scale for publication in some future issue of the ASTM BULLETIN.

F. L. LAQUE

What I wish to concentrate on are two principal advantages of ASTM standards as they affect our relations with other countries. In each case, the advantage is reciprocal. It helps us and it helps the other countries.

Our government is committeed to a policy of providing technical assistance to other countries, and particularly to what are called "underdeveloped" countries. It will be readily recognized that in the field of materials, the 14,359 pages in the ten volumes of ASTM standards comprise the greatest concentration of immediately and practically usable information that it would be possible to furnish anyone needing such data. The materials specifications and the methods of test by which properties of materials are appraised represent a sort of distillation product from the tremendous amount of materials research that has been carried out over the years by ASTM or under ASTM auspices. In most cases, no further work or search for data should be required to characterize a material needed for some specific purpose whether it be concrete for a wall, steel for a bridge, or fuel for an engine. The methods of test that are described provide not only a basis for inspection of what is furnished, but indicate, as well, the paths that may be followed in the search for new and improved materials.

It should be evident, therefore, that through its work on standards, the ASTM has made a unique contribution to the ability of this country to lend technical assistance to other countries.

President LaQue prefaced his Luncheon address with the following remarks:

Before dealing with the principal topic of these remarks, I wish to offer some tributes.

The first is to our Executive Secretary, Bob Painter. During the past year he has demonstrated amazing courage in standing up to his persistent afflictions. His dogged determination, never-failing good nature in the face of disappointments, and his continuing contributions to the welfare of the ASTM, have been an inspiration to the Officers of the Society, the Staff, and his many friends who have been aware of the circumstances.

The second tribute is to Ray Hess and his Headquarters Staff who have done a remarkably good job under most trying conditions. I was going to say an amazingly good job, but in view of their past records it was not at all amazing that they should have come through so well in coping with the many problems that have confronted them.

My final tribute is to my fellow Officers on the Board and the chairmen of the several administrative and technical committees who were principally responsible for the activities that constitute the record of your Society's accomplishments. As the Directors' report will show, your Society had a reasonably satisfactory year in which substantial progress was made on several fronts, and particularly in the case of our new Division of Materials Sciences. We can look forward to a continuation of this progress under the guidance and stimulation of my successor, Allan Bates, and the Board of Directors whom you have elected to work with him.

* Vice-President, Manager of Development and Research Division, The International Nickel Co., Inc., New York, N. Y.

Outgoing President F. L. LaQue (left) passes the symbolic gavel to newly elected President A. Allan Bates.

A second value of ASTM standards is related to their use by foreign purchasers in connection with the procurement of goods made in this country and furnished in accordance with ASTM standards. The first value is to the purchaser who finds an ASTM standard to be the best available way for him to describe what he wants and to be sure he gets what he has asked for. This latter aspect takes the form of evidence of compliance with the standard based on a precise means of inspection.

Such use of ASTM standards in the purchase of goods made in this country is of obvious benefit to domestic producers in increasing the volume of their export business. It provides a ready means whereby the extra value associated with the quality and precision represented by ASTM standards can be described to a prospective purchaser in a way that he can recognize. They also afford assurance that the required qualities will be delivered. A greater use of ASTM standards in foreign trade should go a long way toward improving the demand for such high-quality materials and in counteracting the dubious economic advantage of lower-grade materials of uncertain and undefined qualities. Such lower-grade materials usually are offered from sources able to quote lower prices based on low-cost labor working to undefined standards.

Past-President K. B. Woods enjoys his role as presiding officer at the President's Luncheon.

It seems safe to conclude that U. S. manufacturers are not likely to be able to compete with the products of cheap foreign labor on a price basis. In competing on the basis of superior qualities that can be described, assured, and measured by reliable means, nothing will be more helpful than the general use of ASTM standards as a basis for offer and purchase.

Industry in this country should cultivate the advantage offered to them by the use of ASTM standards abroad by identifying its products with these standards to the fullest possible extent and by cultivating the use of such standards by foreign purchasers of their products.

For the reasons just described, it is most essential that steps be taken to make ASTM standards more readily usable outside this country. This will require translation of the standards into other languages. A necessary first step in each case would be the preparation of a glossary of terms in the language of the proposed translation to take into account the pertinent idiom as well as the formal language of the other country. Presumably, such translations and their publication would have to be undertaken in appropriate stages,

HEAD TABLE GUESTS, PRESIDENT'S LUNCHEON

Left to right: R. E. Hess, associate executive secretary, ASTM; A. A. Jones, chairman, Award of Merit Committee, Anaconda Wire and Cable Co.; R. A. Schatzel, ASTM past-president, vice-president and director of engineering, Rome Cable Corp.; Farrington Daniels, Marburg Lecturer, professor emeritus, University of Wisconsin and president, National Academy of Sciences; L. J. Markwardt, honorary member, assistant director, U. S. Forest Products Laboratory (retired); A. A. Bates, ASTM president-elect, vice-president of research and development, Portland Cement Assn.; F. L. LaQue, ASTM president, vice-president and manager, Development and Research Div., The International Nickel Co., Inc.; K. B. Woods, ASTM past-president, head, School of Civil Engineering, Purdue Univ.; M. N. Clair, ASTM vice-president, president, Thompson & Lichtner Co., Inc.; Milos Polivka, assistant professor, Engineering Materials Laboratory, University of California, representing R. E. Davis, recipient of F. E. Richart Award; C. H. Scholer, chairman of F. E. Richart Award Committee, professor of applied mechanics, Road Materials Laboratory, Kansas State College of Agriculture and Applied Science; R. C. Dalzell, Gillett Lecturer, assistant to the director, Division of Reactor Development, U. S. Atomic Energy Commission; R. W. Seniff, ASTM vice-president elect, manager of research, The Baltimore & Ohio Railroad Co.; and R. J. Painter, executive secretary, ASTM.

The President's Address

determined by priority of interests in particular areas.

A start along the lines indicated has been made with special reference to Latin America. We have had conversations with officials of the U. S. Departments of Commerce and State and have reason to hope that considerable help will come from these sources. For its part, the ASTM has offered these governmental departments the free use of its standards material and its full cooperation in making ASTM standards more readily usable in other countries.

Special efforts have been made over the years to assist Latin American countries in the organization of standardization activities. For example, in 1957, Dr. Bates and Mr. Painter participated in an Inter-American Standards meeting held in Rio de Janeiro under the auspices of the Inter-American Economic and Social Council of the Organization of American States. More recently, there has been some renewed activity through the International Cooperation Administration. Through these and other appropriate channels, it is hoped that further progress can be made toward standardization and the use of ASTM standards in Latin America. Many of us believe that aside from the technical and industrial benefits arising from the use of ASTM research and standards, much good will is generated. This could be a most important by-product.

I recommend to my successors that they make a most diligent effort to pursue this matter on a broad international scale and thereby insure that this aspect of ASTM activities in the international field will be of maximum benefit to our foreign friends, to American industry, and to the Society itself.

YOUR HOSTS . . .

AT THE 63rd Annual Meeting were the members of the Philadelphia District Council. As they have so often in the past, these capable men played an important part in the meeting arrangements.

Chairman of the District Council is Allen H. Kidder, Philadelphia Electric Co; arrangements for the dinner and entertainment were made by H. W. Stuart, U. S. Pipe and Foundry Co.; and J. J. Moran, Kimble Glass Co., was in charge of ladies' entertainment.

63rd Annual Meeting

Symposia and Sessions

Concrete

Early freezing affects differently the interior and the surface of low-density aggregate type concretes, according to I. A. Benjamin and G. D. Ratliff, Jr., of Granco Steel Products Co., St. Louis, Mo. According to their studies, the interior suffered severe strength retardation but little permanent damage if it froze before the age of 5 hr. The surface suffered scaling or complete loss of strength if it froze before an age of about 20 hr. Outdoor freezing was found to be more damaging than artificial freezing with the same temperature cycle.

In a paper describing an investigation of alkali reactivity of the fine and coarse aggregates of Northern Illinois, J. F. Weigel of the Medusa Portland Cement Co. observed that the use of the quick chemical test for reactivity and the present criteria for judging potential alkali reactivity petrographically may not be entirely reliable as a means of determining whether a given aggregate is likely to be reactive to the degree that it will cause expansion or distress of a concrete structure. Many aggregates that have been suspect as a result of these tests often have long service records of satisfactory performance.

Durability of concretes made with different aggregates depends upon the rate at which these aggregates become critically saturated in the concrete and the physical response of these aggregates to freezing. George Verbeck and Robert Landgren, Portland Cement Assn., pointed out in their paper "Influence of Physical Characteristics of Aggregates on Durability of Concrete," that the mechanism of saturation of aggregates is considered in terms of their physical characteristics and the characteristics of the mortar protecting the aggregates from water. Effects on concrete durability of freezing various saturated aggregates was believed to depend upon the pore characteristics of the aggregate and the rate of freezing of the concrete.

Glenway Maxon, consulting engineer, in his paper, "Testing Performance of Stationary Concrete Mixers," and I. Narrow, Corps of Engineers, in his paper, "Performance Tests of Field Concrete Mixers," described many of the methods in use for sampling plastic concrete in stationary mixers to evaluate mixer performance. A list of suitable tests for evaluating mixer performance was suggested. Both speakers maintained that testing of mixer performance is practical and desirable.

High Temperature

The service life of many missiles is only a few seconds or minutes. In that short time some components of the vehicle get extremely hot, and while hot must sustain large loads. How the materials used in these machines will behave when subjected to such rapid heating is a design problem that the papers presented in the High Temperature Sessions attempted to answer.

The data presented in a paper "Strength of Structural Alloys Under Conditions of Rapid Heating and Rapid Loading," by D. W. McDowell, Jr., The International Nickel Co., Inc., and J. R. Kattus, Southern Research Inst., should be of great value to the designer of missiles. The authors illustrate the effects of variations in heating and loading time, from 1 sec to 30 min, on the load-carrying capacity of three stainless steels and three nickel-base sheet materials at temperatures up to 2000 F. This paper also described the beneficial effects of cold working at sub-zero temperatures on the short-time strength of austenitic stainless steel.

One of the problems in testing materials under conditions of rapid heating is to get the specimen to the required temperature in the required short times. Several techniques have been used, such as induction, radiant, and resistance heating, and in some cases immersion in hot molten substances has been employed.

A technique using an induction coil and an automatic control system was described in a paper on the "Application of Induction Heating to Short-Time Elevated Temperature Tension Testing" by A. P. Levitt and A. G. Martin, Watertown Arsenal. They conducted tension tests on titanium specimens at various temperatures. With few exceptions, the total time for heating and testing a single specimen was less than 1½ min, of which the major portion was heating time. Induction heating has certain advantages, according to the authors. It prevents overheating of sensitive regions, permits heating with-

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out direct contact with the specimen, and it eliminates specimen contamination by the heating medium.

Jay F. Bureham, Lockheed Aircraft Corp., in a paper on "Preliminary Evaluation of Thermocouple Attachment Methods for Radiant-Heating Applications," described an investigation to secure information on the thermocouple performance in tests of materials and structures raised to elevated temperatures by radiant-heat techniques. Eight different methods of installing thermocouples were tried to compare the accuracy and reliability of various methods of attachment. The results demonstrate that the method of installation has a significant effect on the accuracy of temperature measurement made by thermocouples exposed to radiant heating.

Rapid heating techniques were used for testing sheet compression specimens of magnesium alloys. R. W. Fenn, Jr., Dow Chemical Co., in a paper on "Compression Testing of Sheet Magnesium Utilizing Rapid Heating," described test equipment for determining compressive stress-strain curves of magnesium sheet alloys at temperatures of 300 to 1000 F for times of 5 sec to 15 min and strains up to 2 per cent under conditions of rapid heating by the resistance-heating method. A high-amperage alternating current was passed longitudinally through the specimen. The equipment consisted essentially of a tension-creep machine rebuilt to permit direct application of compression loads. Lateral support of the specimen was obtained with a stainless-steel jig having two ground and polished supporting plates.

Fatigue

A mechanism for the formation of microcracks in fatigue, still an unsettled question, was postulated by Melvin A. Wilkov, The Pennsylvania State University, in his paper, "New Observations Relating to the Mechanism of Fatigue Failure." Using shadowed carbon replicas and the electron microscope to peer into the crystalline microcosm, Mr. Wilkov repeatedly examined the surfaces of specimens of 4340 steel at stages throughout fatigue testing. He observed first the appearance of slip lines, then the formation of cavities on the glide planes, then the growth of these cavities into microcracks. The cavities, he concluded, were formed by the diffusion of vacancies produced through the motion of dislocations. When a specimen containing such cavities was tested to failure in static tension without growth of cavities or formation of microcracks, Mr. Wilkov concluded that, in fatigue, the formation of the microcracks must be through growth of the cavities by their acting as a sink for vacancies rather than by rupture at their edges due to stress concentration. Mr. Wilkov stated that the question of the nucleation of the cavities is still open.

Quality of Observations

What is precision? What is accuracy? With the sophistication that is necessary for proper interpretation of data, it is indeed naïve to consider precision as simply the degree of agreement of repeated measurements of the same property, expressed as dispersion of test results around the arithmetic mean—or to define accuracy as the difference between the average and the "true value." To these oversimplified definitions the statistician says yes—*but!* And it was to just this *but* that the Symposium on Quality of Observations, sponsored jointly by Committee E-11 on Quality Control and the Administrative Committee on Research, was directed.

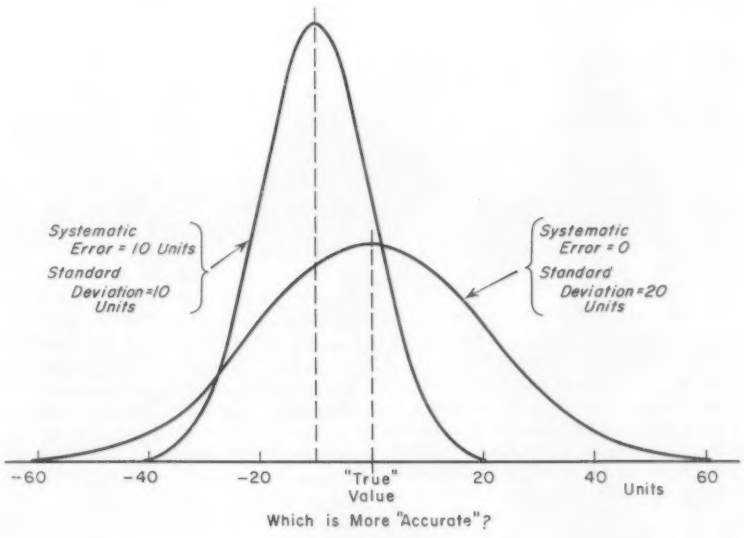
According to R. B. Murphy, Bell Telephone Laboratories, the problem is largely one of attempting to balance rigor and exactness against practicality and simplicity. But it is important in ASTM work that there be a standard for reference, and Committee E-11 has for some time been attempting to reach agreement on basic definitions of precision and accuracy. Accuracy cannot be defined without first settling on a meaning for a reference level—"true value," or "target value." Dr. Murphy would settle for defining the term accuracy as including both bias (or systematic error) and precision. The present position of Committee E-11 on which there is good agreement, said Murphy, is that accuracy should connote the idea of the error of individual measurements when that error is compounded of bias or systematic error and random or nonsystematic error.

W. J. Youden had more to say about defining the "true value" as it affects the concept of accuracy. Dr. Youden raised one very interesting question: "Is a procedure with a small systematic error to be preferred to one with practically no systematic error if the latter has much poorer precision?" Many answer this question, illustrated in the accompanying figure, in favor of the more precise method with the systematic error. There is no concensus for this conclusion, however, as certain conditions may favor the opposite view.

W. S. Connor, Research Triangle Inst., showed the importance of deliberate randomization of all uncontrolled variables to achieve normal distribution of statistically independent data having the same variance and thus to arrive at valid statements of precision.

Milton Terry, Bell Telephone Laboratories, showed how new techniques of analysis of residuals, multiple comparisons, and components of variance can supplement analysis of variance in answering many questions about processes and planned experiments not possible to answer by analysis of variance alone.

While the speakers and participants did not settle the questions of defining precision and accuracy, they did significantly illuminate the picture, leaving all with a better concept both of the importance and meaning of these terms.



Cement and Plaster

A suggested modification of ASTM Method C 26 by substituting a cone-type plunger for the present cylindrical plunger was proposed by R. A. Kuntze of the Ontario Research Foundation in his paper "An Improved Method for the Determination of the Normal Consistency of Plasters." Experimenting with cones with apex angles of 45 deg, 53 deg 08 min, and 60 deg, Mr. Kuntze found that it is possible to determine the normal consistency of a plaster by a single test. The method is based on the fact that a linear relationship exists between the penetration depth of a conical plunger and the water-to-calcined-gypsum ratio of a plaster. By using a calibration factor, the normal consistency of a plaster can be calculated from a single penetration value. Since repetitive tests are unnecessary, the method saves time.

Qualitative identification of hydration products of portland-cement pastes were described by D. L. Kantro, L. E. Copeland, and Elaine R. Anderson, Portland Cement Assn., in their paper, "An X-Ray Diffraction Investigation of Hydrated Portland-Cement Pastes." In the past, numerous investigations have been made in an attempt to identify the products of hydration of portland cement. However, because of the complexity of the products, conflicting results have been published at different times. In earlier investigations by X-ray diffraction, the Debye-Scherrer powder photograph method has been used for the most part. The relatively recent development of the diffractometer represents a major improvement in this field. It is now possible to obtain greater resolution so that important details heretofore unknown are revealed. Some products not previously identified by any means have been identified by X-ray.

M. F. Kaplan of the Council for Scientific and Industrial Research, Pretoria, South Africa, discussed reproducibility of flexural and modified cube compression tests on hand-mixed and compacted mortar specimens, in his paper, "The Reproducibility of Tests for Determining the Strength of Portland Cement." The investigation involved more than 2000 tests. The results are compared with those of the CEMBUREAU tests, in which the mortar test specimens are mechanically mixed and molded, the British Standard compression tests on concrete and vibrated mortar cubes, and the ASTM Methods of Test for the Tensile and Compressive Strength of Hydraulic Cement Mortars.

N. G. Zoldners, Department of Mines and Technical Surveys, Ottawa, Canada, spoke on "The Effect of High Temperatures on Concretes Incorporating Different Aggregates." Concrete has long been recognized as an excellent fire-resistant building material, and many data on its fire protective characteristics are available. Present-day uses of concrete in building and industrial installations, runways for jet aircraft, atomic reactors, and missile launching pads require additional information on the effect of high temperatures. Mr. Zoldners reported that, in general, results indicated that, after heating to 200 or 300 C, the residual compressive strength of concrete increased up to 10 per cent over the original strength, partly due to heat-stimulated cement hydration of water still available in the specimen. Strength dropped rapidly after exposures above 500 C due to dehydration of the cement paste. Deterioration effect was observed first in concretes of higher thermal diffusivity.

Within the scope of the investigation, it was concluded that portland-cement concrete prepared with commercial aggregates deteriorates on exposure to elevated temperatures. Extent of deterioration is dependent to a large degree on the type of aggregate. Results showed evidence that flexural strength is more seriously affected by such exposure than compressive strength.

Shear and Torsion Testing

Four papers in the Symposium on Shear and Torsion Testing reported results of work with the new photoelastic coating technique for stress-analyzing structures. Felix Zandman, The Budd Co., who brought this French process to America three years ago, presented the first paper on this topic, stating that this technique permits rapid qualitative surveys of large structural areas. Accurate quantitative analysis in regions of interest may also be made immediately. These coatings also offer distinct advantages for understanding the behavior of a part, allowing the analyst to locate regions of wasteful low stresses, dangerous high stresses, local yielding, and other important phenomena. These effects can be recorded using photographic, television, stroboscopic, and photoelectric systems. Advantages and disadvantages were reviewed.

C. S. Yen, Douglas Aircraft Co., used the photoelastic technique to evaluate single-shear sheet specimens with double slant notches (reported in ASTM *Proceedings*, Vol. 58, p. 862 (1958) and adopted by Aerospace Industries Assn.). The author reported that this type of specimen showed neither pure nor uniform shear stress in the critical area. Therefore these specimens are deemed inadequate for determining shear creep, although they may be satisfactory for determining ultimate shear strength for sufficiently ductile materials.

E. J. Zapel, Boeing Airplane Co., discussed the design and development of a new approach to a tensile-loaded shear specimen. The shear-difference technique was used to analyze the photoelastic data and to determine that there was no bending moment across the minimum section of the notch. Data were presented to show that this tension-type shear coupon is considered to be the most suitable specimen configuration for determining shear properties of either thin sheet materials or sheet and plate materials at high temperatures.

An investigation to determine the general strain distribution across a spotweld section was presented by N. A. Freytag, The Budd Co. The photoelastic coating technique was employed to gain a more complete understanding of the nature of a spotweld's ability to carry load and to give further insight into spotweld shear failure. This technique has shown that the highest stressed areas for the test specimens occurred away from the forged area surrounding the spotweld rather than on the edge of the forged area as had been previously suspected.

L. R. Lunsford, Convair, decried the lack of adequate methods to evaluate the bond or joining properties of adhesives. He pointed out that existing specimens for shear testing vary considerably and none is completely satisfactory. However, adhesives are usually reported in terms of shear strength without even giving the configuration of the specimens used. Lunsford stated that dependency on the lap-shear specimen should be avoided if possible, except as a quality control device, and even then its usefulness should be demonstrated statistically. At best only a few of the factors affecting joint strength can be evaluated. The limitations of an empirical approach and an approach utilizing the theory of elasticity were presented and discussed. Both methods of obtaining basic adhesive properties are in the early stages of development and will require much additional work.

The Forest Products Laboratory has conducted extensive studies of shear and torsion tests for wood and wood products over a long period of time. W. G. Youngquist and E. W. Kuenzi reported on eight shear and three torsion tests that have been studied at length and are regularly used to obtain data on wood and wood products.

N. G. McCrum, du Pont Co., used the torsion pendulum to study high polymers. Measurements were made over an extended temperature range at low

frequencies. The mode of operation and theory of the torsion pendulum for determining torsion modulus and logarithmic decrement were given.

A technique for torsion testing of graphite at temperatures up to 2800 C was developed by C. E. Waller and M. L. Stehsel, Aerojet-General Corp. The graphite rod specimen was connected to the ends of two shafts in a furnace having a helium atmosphere. A torque exerted by the shafts on the specimen was measured to give data on shear stress and relaxation and creep. The authors noted that future tests should use a tube specimen for more accurate results.

R. S. Shane, General Electric Co., reviewed experiences with metal cleaning procedures for aluminum, stainless steel, and magnesium for adhesive bonding. The efficacy of these preparations were evaluated by using the lap shear test. In order to ensure reliable test results, modifications were made of the test procedure of ASTM Method D 1002 that resulted in a much smaller than usual standard deviation in the test results. A method of modifying a standard tension test machine to permit uniform application of tensile stress and thus improve the test results was discussed.

Low-Temperature Properties of High-Strength Aircraft and Missile Materials

The low-temperature properties of materials have assumed great importance since the development of liquid-fueled rocket engines as prime propulsion systems. A great deal of work is under way to determine the mechanical properties of materials being used at these low temperatures.

The papers presented in this symposium explored the mechanical properties of various alloys for use at temperatures ranging down to −423 F. Most of the alloys tested were in sheet form, either heat treated or cold worked to obtain optimum strength-density ratios.

One study by G. B. Espey, M. H. Jones, and W. F. Brown, Jr., National Aeronautics and Space Agency, provided data showing that recently developed titanium alloys have strength-to-weight ratios superior to the best commercially available steels. The purpose of this investigation was to develop information on the behavior of these alloys in the presence of very high stress concentrations.

Satellites and other space craft are subjected to thermal cycling at temperatures between cryogenic and moderately elevated. The effects of thermal cycling at various heating rates on aluminum and magnesium alloys were reported. The mechanical and physical properties of aluminum, nickel, iron, copper, and titanium-base alloys, and even plastics, were discussed in relation to design of rocket-engine components subjected to low temperatures. The low-temperature properties of precipitation-hardening stainless steels were compared with the properties of austenitic stainless steels, nickel, titanium, and aluminum alloys on a strength-weight ratio.

Since weldability is of major importance in the fabrication of these vehicles, data pertaining to the low-temperature properties of welded joints in these alloys were also reported. The behavior of weldments was compared with that of wrought alloys. Some studies show that the properties of the wrought material cannot be extrapolated to the weldment and that the behavior of weldments is not understood sufficiently to allow prediction of their low-temperature behavior.

Radiation Effects and Dosimetry

The behavior of high-polymer materials in a radiation field depends on a number of non-nuclear factors that are usually neglected in conventional testing. So stated E. G. Fritz, Convair, in the opening paper of the Symposium on Radiation Effects and Radiation Dosimetry. The factors referred to include initial molecular weight distribution, molecular architecture, reaction mechanism, and specimen thickness.

In a paper entitled "Irradiation Testing of Enrico Fermi Prototype Fuel Pins in the CP-5 Reactor," co-author A. A. Shoudy, Atomic Power Development Assoc., presented data on the radiation stability of uranium–10 per cent molybdenum. Tests of full-length pins with burnups ranging from 0.27 to 0.85 per cent of the total atoms fissioned have verified predicted high-temperature allowable burnups but have shown that under certain conditions excessive swelling could occur at low temperatures. Through correlation of diameter measurements, temperature, and post-irradiation metallographic analysis, it is concluded that the radiation stability of the alloy depends heavily on the metallurgical condition of the material. The γ phase, stable above 1060 F, resists radiation more effectively than the $\alpha + \delta$ phases, which are thermally stable at temperatures less than 1045 F.

J. R. Hawthorne and L. E. Steele, U.S. Naval Research Laboratory, used Charpy V-notch and drop-weight specimens to show that changes in transition temperature on the order of 250 F were possible for various steels and weld metals irradiated in different nuclear and thermal environments to integrated fast-neutron flux exposures of 1×10^{19} NVT (> 1.0 Mev).

In another paper by the same authors it was shown that the correct interpretation of radiation effects upon materials depends upon accurate knowledge of neutron exposures. Some of the problems associated with neutron dosimetry include: choosing the best monitors, interpreting preliminary neutron flux surveys, measuring and interpreting flux levels under changing reactor conditions, and using flux data in the analysis of radiation effects.

D. Binder, Oak Ridge National Laboratory, showed that although the energy absorbed by materials in a pile may be measured directly by calorimetric methods, neutron threshold and resonance reactions provide a less difficult means for estimating the neutron spectrum and may be used to calculate the energy absorbed from neutrons. Agreement with calorimetric measurements are within 20 per cent and dependent on the neutron spectrum.

Other papers presented discussed radiochemistry and mass-spectrometry techniques for fuel depletion studies, neutron spectrum determinations at low-flux levels, the effect of sample parameters on energy absorption from a neutron beam, and description of a solid-state Bragg-Gray cavity chamber.

Metallographic Specimen Preparation

Metallography has been emphasized over the past few years as one of the most important tools of the metallurgist in the continuous search for new and better metals, ceramics, and cermets for nuclear and missile applications. As a result several new metallographic techniques have been developed, and a number of existing techniques have undergone modifications.

Papers in this symposium described and evaluated several new techniques including vibratory polishing, chemical polishing, attack polishing, and cathodic vacuum etching. Several papers pointed out the usefulness of the presently available diamond abrasive in previous problem areas. The remote metallography of irradiated specimens was also described.

One paper not listed in the preliminary program outlined a procedure for the preparation of polished sections of ceramic materials wherein a system of rapid preparation for final polishing results in a minimum of pitting.

Materials Sciences

Ceramics that can be worked and heat treated like metals are not only likely possibilities but have actually been demonstrated in the laboratory, though commercial applications may be some time in the future. Only little more than ten years have elapsed since dislocation theories of metals and ionic crystals have been proved by laboratory observations. The research that followed during the past decade, and especially the last four years, has enabled explanation of a great many previously baffling phenomena about the nature of crystalline solids—especially strength and plastic flow. Also, research is well on the way toward explaining the mechanism of fracture. But to tie all of solid-state theory into a neat package and to use it to predict properties of materials may be a long time in coming, according to Harvey Brooks of Harvard University, speaking at a symposium sponsored by the Materials Sciences Division. Prof. Brooks did say, however, that solid-state theory has already been useful in predicting properties of composites where properties of individual materials are known from measurement.

Crystal Defects Seen as Key to Ductile Ceramics

According to Earl R. Parker of the University of California, ductility has been observed in many nonmetallic crystalline materials. As in metals, the ductility or plastic flow in nonmetallic crystals occurs by the movement of dislocations along slip planes. Likely candidates for study among the ionic crystals are those with cubical structures, since they have a high degree of symmetry with numerous slip systems, and plastic adjustment at grain boundaries can occur without crack formation. Examples are the alkali halides, silver halides, and magnesium oxide. The last offers especially interesting possibilities, for it is ductile at room temperature and does not show surface effects as do the alkali halides.

While there are a number of possible sources of dislocations that can be caused to move on application of stress, a major one, according to Prof. Parker, is the presence of small foreign particles. While dislocations are necessary for ductility, strength can be developed only by placing barriers in the way of dislocation movement, making slip more difficult. Very effective barriers, it has been observed, are networks of dislocations. These networks have been shown to be formed generally by stresses due to temperature gradients or restraints imposed on objects such as mold walls, etc.

While mechanisms of crack formation and fracture are not yet fully explained, there is good evidence that cracks may be started at points where dislocations pile up, such as at grain boundaries and slip bands. After the crack is formed, however, a certain energy is required for propagation, and a crack does not necessarily result in fracture.

Ceramic "alloys" or compounds with deliberately introduced impurities have interesting properties. An example is shown by the "doping" of a lithium fluoride crystal with iron oxide; a very small addition of the oxide will greatly increase the strength of the crystal. Ionic crystals can also be heat treated and precipitation hardened in a way analogous to that of metals, observed Prof. Parker.

Acoustical Fatigue

Acoustical, or sonic, fatigue is a child of the jet and rocket age. Noise levels produced by the powerful blast of a jet exhaust are high enough to excite damaging vibrations in the airframe structure. It is estimated that about 1 per cent of the energy in the fuel of a large jet engine is converted into sound —this means that sound energy is produced at the rate of about 50,000 watts. Furthermore, this noise covers a random, broad frequency spectrum that includes most of the important modes of vibration of airframe structures. At some of these frequencies, millions of stress cycles can be accumulated in a matter of hours.

Many problems are posed by this upstart phenomenon—some old, mostly new: (1) how to predict or measure the noise spectrum to which a structure is exposed, (2) how to determine the stresses and vibration modes produced by that noise, (3) how to predict the fatigue life under such random loading, (4) how to verify that prediction, and (5) how to design for increased fatigue life. All these problems were touched on at the Symposium on Acoustical Fatigue.

A. M. Freudenthal, Columbia Univ., in presenting his paper, "Fatigue of Structural Metals Under Random Loading," and that of W. Weibull, Bockamöllan, Sweden, "The Fatigue Damaging Effect of a Random Load," wrestled with the statistical aspects of random loading and proposed methods for correlating results from variable-amplitude fatigue tests with those from constant-amplitude tests. Since the latter are much easier to make and since there is already in existence a vast body of data from such tests, it will behoove engineers to find a way to make use of constant-amplitude test data in random-load situations. Freudenthal attacked the problem in terms of an "interaction" between infrequent, high-stress amplitudes and the dominant, low-stress amplitudes, and introduced an "interaction factor," with the aid of which he demonstrated the validity of a pseudo-linear rule of cumulative damage for structural aluminum. Weibull discussed certain parameters for specifying a random load and suggested that fatigue tests run with systematic variation of these parameters may be used to correlate with results from constant-amplitude tests.

Equipment for acoustical fatigue testing is still under development. At present, the only reliable test is one that takes place in the actual service environment—behind an operating jet engine. Although this is almost prohibitively expensive, it is still the most common

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test for final approval of a structure. D. M. Forney, Jr., Wright Air Development Div., in his paper, "Experimental Techniques and Equipment for Acoustical Fatigue Research and Development," described some of the equipment now being developed in industrial and government laboratories for use in development testing of structures. Sirens are now widely used, although the results from tests with these noisemakers must be modified to account for the fact that only one frequency is produced and thus only one mode of vibration is excited. High-intensity sirens producing randomized tones are, however, under development. Other types of exciters in use are air blasts, air jets whose pressure is modulated by movement of a loudspeaker voice coil, and scaled-down model jet engines.

W. J. Trapp, Wright Air Development Div., and B. J. Lazan, University of Minnesota, in their paper, "Material Properties Which Affect Acoustical Fatigue Life and the Role of Damping," concluded that the most hopeful avenue to explore in the search for methods to strengthen structures against acoustical fatigue is to increase damping. They felt that much can be done toward working out design concepts that use to the fullest the damping inherent in the structure itself, that is, material hysteresis, rubbing at contact surfaces, and shear in adhesives.

Nuclear Methods in Soils

The discovery of the neutron has led to many startling developments which already have had a major effect on the future of civilization. It is of interest to note one development which has supplied a much needed tool in the study of soils and their use for engineering purposes.

Some ten years ago the application of radioisotopes to the measurement of soil moisture content and density was first developed. Soil and foundation engineers have long needed an accurate and rapid means for the determination of these properties in soil used in compacted fills.

Quite recently, at the instigation of several organizations, including Cornell University, the Civil Aeronautics Administration, and the Corps of Engineers, instruments have been developed using the nuclear method. One such instrument, known as the surface-type nuclear soil meter, has been used on several important projects with considerable success.

These experiences and results were presented in an interesting manner at the Symposium on Nuclear Methods for Measuring Soil Density and Moisture. The symposium was conducted as a panel forum with a brief digest of six papers being presented, followed by discussion in which the authors of the papers participated as the panel members. This resulted in a series of questions and answers which were recorded and will undoubtedly be included in any planned publication.

One of the projects on which the surface density meter was used was in the construction of the pavement at Clinton Air Force Base, Ohio, by the Corps of Engineers. P. F. Carlton, Ohio River Division Laboratories, described the capabilities and limitations of the apparatus as used on this project. Precision of the nuclear method approached that of conventional direct sampling methods. The time required per test was much less than that for conventional methods and the cost was reduced by one-half. Adherence to simple rules for safe handling kept radiation exposure to operating personnel well within safe limits.

Experiences at a second site—the O'Hare Field project in Chicago—were included in a paper prepared by John P. Gnaedinger. This work included correlation with the sand cone method (ASTM Method D 1556 T). On this project correlation was not clearly established; results ran consistently lower than the sand cone method. However, the author pointed out that better performance could be expected if the instruments are calibrated for each soil type and if further improvement is seen in instrument operation.

Three highway projects in New York State provided sites for comparing the results of the nuclear methods, using the surface density meter, and the sand cone method. Sidney Mintzer, New York State Department of Public Works, described tests performed in 1959 involving four basic soil types. These tests represented preliminary phases of a program to establish the suitability of the nuclear method for embankment compaction control, and no conclusions were drawn. Further tests will be continued recognizing the possibilities of this method in providing a rapid test procedure.

The AASHO Road Test near Ottawa, Ill., provided an excellent opportunity for an evaluation of the nuclear method. W. N. Carey, Jr., J. F. Shook and J. F. Reynolds, Highway Research Board, presented information collected from tests using two nuclear devices for measuring density—one developed at the AASHO Road Test and the other a commercial instrument. One nuclear surface-type moisture gage was also used as well as the rubber balloon density measuring device. The investigation showed that density can be measured satisfactorily by nuclear gages of the flatiron type. These devices would be more effective than other devices if statistical sampling and analysis were specified.

K. N. Burn, Division of Building Research, National Research Council of Canada, described in his paper the design and calibration of a neutron moisture meter consisting of a probe using an actinium-beryllium neutron source and a scintillation-type detector. The author outlined a series of calibration tests using other than natural soil materials, such as bentonite-water-sand mixtures, which indicated small deviation of results and thus showed the stability of the instrument. Accuracy of the instrument appeared to be very good as noted from the calibration curve.

O. K. Neville, Nuclear-Chicago Corp., and T. W. Van Zelst, Soiltest, Inc., reviewed the theory of the neutron-moderating facility of hydrogen and its application to an analytical method for determining moisture, first applied to oil-well logging. From this early work was developed the Nuclear-Chicago d/M Gage, the apparatus referred to in three of the other papers. The authors describe the design considerations, the calibration, and the civil engineering applications.

General Testing

In keeping with the greatly increased importance of rockets and the materials for their construction and fueling, occasioned by their employment for such divergent uses as weapons and space exploration, the first paper in this symposium, by R. Kopituk, Thiokol Chemical Corp., was devoted to a new impact detonability tester for evaluating materials in contact with highly reactive oxidizers. A test assembly was described which provides rather good reproducibility and appears to give results that bear a significant relation to the behavior of the same materials in service. The test is adaptable to metals and nonmetals in the form of both solids and liquids.

Another paper, by F. S. Williams, W. Beck, and E. J. Jankowsky, Naval Air Material Center, presented a study of crack propagation in a hydrogen-embrittled notched ring specimen. The specimen and test procedure are so designed as to permit continuous recording of the rate of crack propagation in the stressed embrittled ring as indicated by the decrease in strain gage readings of the load on a bolt by means of which an initial stress was applied to the ring

specimen. The test appears to offer good reproducibility and does not require elaborate equipment.

Other papers covered a detailed study of the flow properties of bulk solids and a full-scale, simulated service-type test for evaluating the resistance of a complete assembly (in this case an aircraft ground support air heater) to shock resulting from a sudden stop at a specified acceleration rate under carefully controlled conditions.

Metals

Atmospheric corrosion test data on a large group of low-alloy steels exposed for 18 years at an industrial location and at two marine locations were reported by H. R. Copson, The International Nickel Co., Inc. These data emphasized the remarkable protective rust coatings developed by some of these steels. Most of the corrosion of such steels occurs early, and further attack is inhibited by the rust coatings developed.

Two other papers dealt with properties of stainless steels which are of current interest. One, by F. C. Hull, Westinghouse Electric Corp., presented quantitative data covering the effect of some 18 alloying elements on the hot cracking of chromium-nickel austenitic steels, using the cast pin tear test. This is a rapid and inexpensive test that produces cracks in chill-cast pins as they freeze and cool under conditions intended to simulate the restraint imposed during welding of heavy sections. These data provide information for the design of casting compositions or welding electrode compositions of greatly improved resistance to hot cracking. The other paper, by Frank Garofalo, U. S. Steel Corp., gave data on the elastic moduli and Poisson's ratio for two commercially available austenitic steels, one a Cr-Mn-N steel and the other a Cr-Mn-Mo-V-N steel, and for a modified type 422 ferritic stainless steel. These data were measured at temperatures of 80, 200, 400, 600, 800, and 1000 F.

Data on the notch sensitivity of generator or turbine rotor forgings of Ni-Mo-V steels, as measured by spin fracture tests, were released in a paper by G. O. Sankey, Westinghouse Electric Corp. The spin fracture test uses a small test rotor taken from a typical forging or forging prolongation, notching to simulate a defect, and spinning so that stresses comparable to service are induced. These tests showed that prestressing at a temperature of about 270 F resulted in an easily recognized improvement in fracture strength when tested at 0 F.

The properties of several ultra-high-strength steels as affected by composition and melting practice were evaluated in two papers. A steel containing 5 per cent chromium, 1.3 per cent molybdenum, 0.5 per cent vanadium, and 0.40 per cent carbon has been furnished to guaranteed minimum specifications for several years in aircraft and missile applications. One paper, by J. C. Hamaker and E. J. Vater, Vanadium-Alloys Steel Co., presented data on this steel covering the effect of vacuum melting and also of varying the carbon content from 0.20 to 0.50 per cent. Properties investigated included room-temperature tensile, sheet tensile, impact, as well as fatigue properties, impact transition behavior, and elevated-temperature tensile and impact properties. The other paper, by J. L. Shannon, G. B. Espey, A. J. Repko, and W. F. Brown, Jr., of NASA, presented data on the effect of carbon content and consumable-electrode vacuum melting in a modified version of the 5 per cent chromium, 1.3 per cent molybdenum steel (vanadium added) as well as the ultra-high-strength 300 M alloy.

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Sharp-edge notch and smooth tension tests were performed for various compositions and heat treatments.

The Brass and Bronze Ingot Inst. has been sponsoring a project to establish accurate mechanical and physical properties of a group of copper-base casting alloys. The results of the second portion of this continuing program were contained in a paper by W. H. Johnson and J. G. Kura, Battelle Memorial Inst., covering five alloys. Properties measured at various temperatures from −40 to 550 F included ultimate strength, yield strength, elongation, reduction of area, modulus of elasticity, compressive strength, impact strength, Brinell hardness, electrical resistivity, thermal conductivity, and thermal expansion. Also

Citations for Quality of Presentation

62nd Annual Meeting—1959

IT IS EXPECTED that any scientist, by ability or training or both, should be able to communicate his thoughts to his fellows through effective presentation of the spoken word, as well as the written. Apart from maintaining the technical quality of all papers presented at meetings of the Society, the Administrative Committee on Papers and Publications is interested in improving the value of the technical sessions by improving the character of presentation of technical papers.

To foster improved communication and to make our technical sessions more interesting and thus more useful, each author is graded on the quality of his presentation. This procedure has been followed for the past five years and has proved very successful. Reporters were assigned this task at the 1959 Annual Meeting. Based upon their reports the four outstanding presentations for 1959 have been selected, and the following four authors are cited:

B. E. Kester, technical director, Missouri Portland Cement Co., St. Louis, Mo., for presentation of his paper on "Acetate Processed Portland Cement."

Bryant Mather, civil engineer, Chief of Special Investigation Branch, U. S. Army Engineer Waterways Experiment Station, Concrete Div., Jackson, Miss., for presentation of the paper on "Effectiveness of Mineral Admixtures in Preventing Excessive Expansion of Concrete Due to Alkali-Aggregate Reaction" by Messrs. Mather and Leonard Pepper.

J. L. McRae, engineer, chief, Bituminous and Chemical Section, Flexible Pavement Branch, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss., for presentation of the paper on "Theory and Application of a Gyratory Testing Machine for Hot-Mix Bituminous Pavement" by Messrs. McRae and C. R. Foster.

R. N. Vendeland, manager, Closed Circuit Dept., Jerrold Electronic Corp., Philadelphia, Pa., for presentation of his paper on "Potential Uses of Closed Circuit Television for Product Inspection."

Bryant Mather

B. E. Kester

Courtesy Fabian Bachrach

R. N. Vendeland

J. L. McRae

Symposia and Sessions

data on fatigue strength, machinability, melting range, pattern.makers shrinkage, density, and specific gravity were presented.

Interest in developing beryllium metal for structural applications, particularly in the aircraft industry, has been spreading rapidly throughout the country. The reasons for this may be found in the unique combination of physical, mechanical, and thermal characteristics found in this metal. However, to meet the requirements of airframe design, a material should be capable of deforming plastically even under complex stress conditions. Five different fabrication techniques were investigated at the Martin Co., and the results were presented in a paper by B. B. Muvdi, Michigan College of Mining and Technology. The best combination of uniaxial and biaxial properties was obtained by cold compacting QMV powder and then hot upsetting the resulting billet.

Road and Paving Materials

A knowledge of the characteristics and properties of bituminous mixtures as well as the bituminous material itself has provided a broad field of research in the study of such mixtures and materials as used in roads and pavements. Committee D-4 on Road and Paving Materials sponsored a group of papers which will make a valuable contribution to engineering knowledge in this field.

J. A. Carpenter, Standard Oil Company of California, described the stress-deformation characteristics of sand-bituminous mixtures. Triaxial compression tests on specimens of medium, uniform sand, before and after stabilization with bituminous binders, were conducted to obtain the basic shearing strength characteristics of the sand and the mixture at varying initial void ratios. As a result of the tests the author believes the strength characteristics of fine-grained, cohesionless soils do not differ appreciably from those exhibited by granular base-course materials. Most mixed soils exhibit the friction-cohesion type strength characteristics typical of sand-bituminous mixtures, thus disclosing that many of the observations are applicable to soil mixtures as well. Among the conclusions drawn were that initial density greatly affects the peak frictional characteristics of cohesionless soils, but ultimately, with strain, both initially dense and initially loose specimens will exhibit the same ultimate strength. It was found that by varying the stress conditions during testing, a Mohr rupture envelope can be defined for the peak and ultimate strength of the tested material, thus revealing the effect of particle interlocking.

The effect of compaction temperature of bituminous concrete mixtures has long been considered as having an important effect on the physical properties of the mixture. Ralph W. Kiefer, Cornell University, reported on the results of a program involving the compaction of specimens at several temperatures using the Hveem kneading compactor. An increase in compaction temperature produced a measurable increase in specific gravity and a decrease in per cent voids. The results showed a measurable change as well in the stabilometer value and cohesiometer value of the compacted bituminous concrete specimens. This means that all specifications based on results of laboratory compaction tests should include a definite laboratory compaction temperature in order to give reproducible results.

Durability of bituminous pavements is a prime requisite. The permeability of asphaltic concrete pavements to air and water is a primary factor in controlling pavement durability, according to W. H. Ellis and R. J. Schmidt, California Research Corp. In their paper, the authors described a new method of measurement that combines the features of being portable and rapid, which is suitable for testing either cores or pavements in any place. The method is based on a head of water which maintains a small constant pressure drop through the pavement or core.

The rheological properties of asphalt have presented an intriguing but difficult field of research. The influence of asphalt composition on its rheological properties was the subject of a paper by R. S. Winniford, California Research Corp. The author presented an outline of asphalt rheology using the fundamental units of stress and shear rate, including the effects of time and temperature. He then explained the phenomena in terms of the composition of the asphalt. Microviscometer measurements on paving and industrial asphalts and on synthetic asphalts compounded from asphalt fractions were made showing that asphalt viscosity is primarily dependent on asphaltene content, while chemical composition of the asphaltenes is an important variable. The author stressed the significance to the asphalt chemist or engineer of the rheological phenomena as revealed by the microviscometer. One of the significant features was that the asphalt which has a high asphaltene content will have a high viscosity at elevated temperature, but at the same time it does not need to be highly thixotropic.

Asphalt emulsions have been in use for road building purposes for a great many years. The varied experience during this period has established the fact that this type of asphalt must be suited to widely varying types of construction. K. E. McConnaughay, K. E. McConnaughay, Inc., presented data which he believes point out the inadequacy of current ASTM specifications for emulsified asphalts. Test methods were proposed of a functional or simulated service nature rather than of the empirical type presently used. The author described a series of tests including a film-forming test for determining the amount of asphalt deposited from an emulsion; a stone-coating test modified from ASTM Method D 244; a viscosity reduction test by stirring; and a settlement test, performed essentially as outlined in ASTM Method D 244, except that readings were made each day for a five-day period.

The closing paper discussed the relatively new cationic asphalt emulsions that are now being used. The authors of the paper were E. W. Mertens, California Research Corp., and L. D. Coyne and E. D. Rogers, American Bitumuls and Asphalt Co. The authors pointed out the lack of availability of proper test methods and specifications for this new type of asphalt emulsion. Tests that have been found useful in evaluating these emulsions were described, as well as modifications of existing ASTM test methods which would make them more useful.

Soils for Engineering Purposes

The overconsolidation of soils when compacted was discussed in the paper by R. W. Cunny and R. C. Sloan, U. S. Army Engineer Waterways Experiment Station. This overconsolidation resulted in shear-strength values higher than that indicated by tests conducted with higher normal pressures. The overconsolidation effect increases with increasing water content within the range used by the authors.

Settlement of soils can become a very serious matter. The observation of settlement of soft, fine-grained soils was discussed by E. J. Zegarra, M. W. Kellogg Co. These observations were made in Delaware, Texas, and Venezuela. Data were presented from borings and from laboratory tests on specimens of material for the purpose of estimating the magnitude and rate of settlement. The author found that test specimens of soft, compressible clays or silts, especially when they contain a high organic content, are adversely affected by sampling and trimming. This cutting and trimming also disturbs the surface and decreases the permeability characteristics of the soil. The esti-

mated time rate of settlement was higher using the laboratory tests than the field performance demonstrated. The computed time of consolidation should be regarded as the maximum or limiting time for field performance.

Triaxial compression is an important property of soils. D. J. Bazett and S. W. Smotrych, the Hydro-Electric Power Commission of Ontario, described triaxial compression tests on drained and undrained samples of remolded Niagara clay. Samples were prepared both in the normal consolidated and overconsolidated states from material with an initial water content equal to the liquid limit. The results of the test are reported in the form of consolidation data, stress paths, the variation of pore-pressure coefficient at failure with overconsolidation ratio, and compressive strength at failure with water content at failure. The authors concluded that drained and undrained tests had common failure envelopes when the samples were normally consolidated or when the samples had the same maximum consolidation pressure.

The distribution of stress and strain in soil masses was described using two full-scale test sections of a runway. R. G. Ahlvin and D. N. Brown of the Soils Division, U. S. Army Engineer Waterways Experiment Station, were authors of a paper which discussed these studies. The authors stressed the importance of prototype stress-strain relations. Two field stress-strain curves were developed for homogeneous soil masses subjected to surface loading. One curve was developed from stresses and deflections measured at points within a large, homogeneous clayey silt field test section and the other within a large, air-dried, homogeneous sand field test section. Conventional construction equipment was used in both test sections. Conclusions drawn were that the triaxial test, as normally carried out, does not yield stress-strain relations representative of those effective in prototype soil structures. Through proper preconditioning of specimens and special loading patterns, prototype stress-strain relations can be essentially duplicated in small laboratory tests. It was found that the laboratory test methods, when applied to tests on undisturbed samples from the homogeneous clayey silt test section yielded stress-strain curves duplicating the field stress-strain curve for all practical purposes.

In construction work, the serious effect of frost action in soils is generally recognized. The rate of freezing and its effect and importance was discussed by E. Penner, National Research Council of Canada, as studied under laboratory conditions. Both saturated and near-saturated moisture conditions were included in the study, with the rate of freezing being measured both in terms of heat flow and rate of frost penetration. Three soils of widely differing properties were used to bring out major differences in behavior to freezing. The primary apparatus used was a frost cell which consisted of two large temperature-conditioned metal plates that determined the temperatures at the top and bottom of a 3-in.-long soil specimen. The results of the study showed the strong influence of net heat flow from the soil on the heaving rate. The average concentration of ice in the frozen soil, resulting from water moved to the freezing zone, increased as the rate of freezing was decreased for all soils. It was found that the proximity of the water table was not critical for any of the three soils used. It was found unsatisfactory to compare the frost susceptibility of different soils in laboratory freezing experiments on a basis of equal rates of frost penetration, because the same amount of heat extracted for two different soils does not produce the same frost penetration. The author felt that the results of this study should be useful in setting up practical laboratory freezing procedures for the realistic evaluation of the frost susceptibility of soils in the field.

These Annual Meeting Papers Are Still Available

SOME of the papers that were not preprinted for the 1960 Annual Meeting were mimeographed primarily for the use of those interested in presenting discussion. A limited number of these are available from ASTM Headquarters at 50 cents each. There is a minimum charge of $1.00 for any order.

Sharp-Notch Behavior of Some High-Strength Sheet Aluminum Alloys and Welded Joints at 75, −320, and −423 F—M. P. Hanson, G. W. Stickley, and H. T. Richards (76D)

Neutron Spectrum Determinations at Low Flux Levels—Paul Kruger (90K)

Shock Testing of Ground Support Equipment and Industrial Items Weighing From 1000 to 50,000 Pounds—W. H. Grumet (84A)

Maximum Shear Strain Measurements and True Yield Point Determination by the Use of the Photoelastic Coating Technique—Felix Zandman (86C)

Stress Distribution in Single-Shear Sheet-Specimens—C. S. Yen (86D)

Shear and Torsion Tests Used at U. S. Forest Products Laboratory for Wood, Plywood, and Sandwich Constructions—E. W. Kuenzi and W. G. Youngquist (86I)

Observed Settlement of Soft, Fine-Grained Soils—E. J. Zegarra (87)

The Compressive Strength of Remolded Niagara Clay—D. J. Bazett and S. W. Smotrych (88)

Duplication of Prototype Stress-Strain Relations by Laboratory Tests—R. G. Ahlvin and D. N. Brown (88A)

The Importance of Freezing Rate on Frost Action in Soils—E. Penner (88B)

Design and Application of the Nuclear Chicago d/M Gauge—O. K. Neville and T. W. Van Zelst (89B)

Experiences with Nuclear Moisture and Density Surface Probes on O'Hare Field Project—J. P. Gnaedinger (89C)

Determinant Sample Parameters in the Radiation Effects Testing of High Polymers—E. G. Fritz (90A)

Irradiation Testing of Enrico Fermi Prototype Fuel Pins in the CP-5 Reactor—M. A. Silliman, A. A. Shoudy, P. R. Huebotter, and W. G. Blessing (90B)

Reactor Spectra Considerations in Radiation Effects Predictions—John Romanko (90D)

Radiochemistry and Mass Spectrometry Techniques for Fuel Depletion Studies, WAPD-T-1113—J. E. Hudgens, Jr., (90E)

The Effect of Sample Parameters on Energy Absorption From a Neutron Beam—R. L. Johnston (90F)

High-Intensity Gamma Ray Dosimetry—D. Hale, D. R. Johnson, S. M. Dec, J. R. Coss, O. Van Sessoms, P. B. Hemmig, R. E. Brocklehurst, and W. L. R. Rice (90G)

A Solid-State Bragg-Gray Cavity Chamber—V. H. Ritz and F. H. Attix (90H)

Measurements of the Energy Absorbed from Pile Neutrons—D. Binder, C. D. Bopp, and R. L. Towns (90I)

Neutron Dosimetry for Materials Irradiation Studies—L. E. Steele and J. R. Hawthorne (90J)

Investigation of Alkali Reactivity of the Fine and Coarse Aggregates of Northern Illinois—J. F. Weigel (98)

Stress-Deformation Characteristics of Sand Bituminous Mixtures—J. A. Carpenter (101)

The Effect of Compaction Temperature on the Properties of Bituminous Concrete—R. W. Kiefer (102)

A Method for Measuring Air Permeabilities of Asphalt Concrete Pavements—W. H. Ellis and R. J. Schmidt (103)

The Influence of Asphalt Composition on Its Rheology—R. S. Winniford (104)

Emulsified Asphalt Tests and Specifications—K. E. McConnaughay (105)

Laboratory Tests and Recommended Specifications for Rapid Setting and Coarse Aggregate Mixing Cationic Asphalt Emulsions—E. W. Mertens, L. D. Coyne, and E. D. Rogers (106)

ASTM Elects New National Officers

President Bates

A. Allan Bates has been vice-president for research and development of the Portland Cement Assn., Chicago, since 1946. He joined PCA after ten years as manager of chemical, ceramic, and metallurgical research at Westinghouse Electric Corp.

A native of Elyria, Ohio, Dr. Bates was graduated from Ohio Wesleyan Univ. with an A.B. degree in 1923. Case Institute of Technology conferred on him the degree of B.S. in metallurgical engineering in 1925 and M.S. in engineering in 1929. He received the degree of Doctor of Science in 1931 from the University of Nancy, France (with honors). Stevens Institute of Technology awarded him the honorary degree of Doctor of Engineering in 1944 and Rose Polytechnic Inst. the honorary degree of Doctor of Science in 1947. He served as professor of metallurgical engineering for two periods at Case, 1927 to 1929 and 1932 to 1937.

During World War II, he took two leaves of absence from Westinghouse, at the request of the government, to perform highly important wartime services. One was a special technical mission for the State Department to South America, the other a secret scientific intelligence operation for the U. S. Army in the combat zone of Germany. This latter mission related to the capture of German scientists and laboratories devoted to research on atomic weapons and other advanced instruments of war.

Dr. Bates has been a member of ASTM since 1946, and of the ASTM Board of Directors since 1955. He has been active in ASTM work for many years as representative of the Portland Cement Assn. on Committee C-1 on Cement and in connection with Committee C-9 on Concrete. As chairman of the C-1 Subcommittee on the Cement Reference Laboratory, he has been especially active in developing the operations of this laboratory which involve the coordinated interests of many private and governmental groups and agencies interested in testing of cements and concretes. He is a member of the Executive Committee of the Building Research Advisory Board of the National Academy of Sciences. In addition, he is a member of the American Concrete Inst., of which he is serving as director; American Chemical Society; American Ceramic Society; American Society for Metals; Western Society of Engineers; the American Institute of Mining, Metallurgical and Petroleum Engineers; American Society of Civil Engineers, Sigma Xi, and Tau Beta Pi.

Vice-President Seniff

Russell Wade Seniff is manager of research for the Baltimore and Ohio Railroad. A native of Illinois, Mr. Seniff received his B.S. degree from Illinois Wesleyan University in 1924. Following his graduation, he joined the Alton Railroad in Bloomington, Ill., as assistant chemical engineer and three years later was promoted to chemical engineer. In 1944 he was appointed engineer of tests for the Alton Railroad and continued in that position upon its merger with the Gulf, Mobile & Ohio in 1946. In 1948 he was appointed engineer of tests for the Baltimore & Ohio Railroad at Baltimore, assuming his present position in 1953.

Mr. Seniff's early railroad work was in the field of water treatment, operation, maintenance, design, and metallurgy of power boilers. Later his work extended to research, design, construction, operation, tests, and inspection of railroad material and equipment. During World War II he was a consultant on locomotive boiler maintenance and boiler water treatment to the U. S. Army Transportation Corps Board and the U. S. Army Corps of Engineers.

Mr. Seniff is author or co-author of almost a score of technical papers dealing with boiler feedwater treatment, operation and maintenance of power boilers and diesel engines, fuels and lubricants.

As the official representative of the Baltimore & Ohio Railroad ASTM membership, Mr. Seniff has been active in ASTM committee work for many years. He is a member of Committees A-3 on Cast Iron and D-2 on Petroleum Products and Lubricants, serving on several subcommittees, and is chairman of Subcommittee III of Technical Committee F of D-2. He has been a member of the Washington District Council since 1953.

Mr. Seniff is also an active member of several other societies. He served as vice-president of the Society of Automotive Engineers in 1951 and is a member and past chairman of its Power Plant Division and a member of its Executive Committee on Fuels and Lubricants. He is a member of The American Society of Mechanical Engineers and the Association of American Railroads, serving as a member of its Specifications Committee, member (past chairman) of its Atomic Energy Committee, and is chairman, Diesel Lubricants & Fuels Committee. He is also a member of the Coordinating Research Council, serving as a member of the Committee on Composition of Exhaust Gases and chairman of the Diesel Vehicle Fuel, Lubricant, and Equipment Research Committee. He is also a member of the executive committee of the National Railroad Lubrication Council.

DIRECTOR

Arthur R. Belyea is chief chemical engineer of the Consolidated Edison Co. of New York, Inc., where he has been employed since 1925. A native of Taunton, Mass., Mr. Belyea received his B.S. in chemical engineering and his M.S. in chemical engineering practice from the Massachusetts Institute of Technology in 1923 and 1924, respectively.

After a brief period of employment with the Bethlehem Steel Co. as a combustion engineer, he was employed by the Consolidated Gas Co. in 1925, which later (1938) became the Consolidated Edison Co. of New York. During this period, his assignments included chemical laboratories, steam engineering, turbine engineering, and process engineering. He has been chief chemical engineer since Dec. 1, 1952.

Mr. Belyea first became active in ASTM work in 1952 as a representative of the Consolidated Edison Co. on Committee D-3 on Gaseous Fuels, serving on several subcommittees. He has represented Consolidated Edison Co. on Committee D-5 on Coal and Coke and Committee D-16 on Industrial Aromatic Hydrocarbons, and currently represents the company as well as The American Society of Mechanical Engineers on Committee D-19 on Industrial Water. He has been an individual member of the Society since 1953.

Mr. Belyea is a licensed professional engineer of the State of New York and in addition to ASTM, belongs to the AIChE, ASME, Society of the Chemical Industry, American Nuclear Society, National Society of Professional Engineers, Society of Gas Lighting, Society of Gas Operators, Edison Engineering Society of New York City, and the American Gas Assn., where he is currently vice-chairman of the Gas Operations Research Committee.

DIRECTOR

Leslie V. Cooper is manager of the Miscellaneous Products Development Dept. of the Firestone Tire and Rubber Co., Akron. He was employed by Firestone in 1922, and since that time has served as service and research compounder on tires, tubes, and solid tires. For many years he was manager of the Physical Testing Div. and Factory Quality Control.

Mr. Cooper received his B.S. degree from Akron Univ. in 1920.

His service on ASTM Committee D-11 on Rubber and Rubber-like Materials began as representative of the Firestone Tire and Rubber Co. in 1935. Currently he is serving on the Advisory Committee of D-11 and heads Subcommittee X on Physical Testing. He is also Committee D-11 representative on ASTM Committees D-20 on Plastics and E-1 on Methods of Testing, and serves on D-11 subcommittees III, IV, VI, XII, XIV, and XVI. He has been an individual member of the Society since 1956.

During the years 1944–1945, Mr. Cooper instructed government inspectors at Akron Univ. He is chairman of the Finance Committee of the Rubber Div. of the American Chemical Society and past-chairman of the Akron Rubber Group. He has served as coordinator of the University of Akron Rubber Group—American Chemical Society lectures on rubber compounding. He is past-president of the Board of Trustees of the Akron YMCA and is active on the Budget Panel of the Akron Community Chest.

DIRECTOR

Jay C. Harris is assistant director of research, detergents, for the Research and Engineering Div. of the Monsanto Chemical Co., Dayton. A native of Bellingham, Wash., Mr. Harris received his B.S. in chemistry from Washington State College in 1927, and his M.S. in 1930. Prior to joining Monsanto, he worked for a year as analytical chemist for the Cerro de Pasco Copper Corp., held a teaching fellowship at Washington State College, and worked for E. I. du Pont de Nemours & Co. as explosives chemist and Colgate-Palmolive-Peet Co. as a detergent chemist. With Monsanto since 1936, he has been successively research chemist; group leader; assistant to the director of research; director, application research, Merchandising Div.; and since 1957 has held his present position.

Mr. Harris served as secretary of ASTM Committee D-12 on Soaps and Other Detergents from 1946 to 1950 and has been chairman since 1950. In 1952, he received the ASTM Award of Merit; and in 1955 the Chemical Specialties Manufacturers Assn. Achievement Award in recognition of his contribution to the fields of detergents and surfactants. In 1959, he received the ASTM Committee D-12 Award for his contributions to the field of detergents. He has been an individual member of ASTM since 1949. Mr. Harris has written numerous papers in various fields of organic chemistry, bacteriology, evaluation of phosphates and synthetic detergents, metal cleaning, application of wetting agents and detergents through industrial processes. He holds several patents in the field of synthetic detergents and textile processing. He is the author of "Detergency Evaluation and Testing," "Metal Cleaning Bibliographical Abstracts," and "Bibliographical Abstracts of Methods for Analysis of Synthetic Detergents."

In addition to ASTM, Mr. Harris is a member of the American Chemical Society, the American Association of Textile Chemists and Colorists, the American Oil Chemists' Society, the American Electroplaters' Society, the Technical Association of the Pulp and Paper Industry, and the Electrochemical Society. He is a member of Phi Sigma Kappa, Phi Kappa Phi, Phi Lambda Upsilon, and Phi Sigma.

DIRECTOR

J. J. Kanter, Industrial Products Group, has been identified with the Crane Company's developments on metals for high temperatures since the early 1920's.

A native of Terre Haute, Ind., Mr. Kanter was educated at the Armour Institute of Technology and the University of Chicago, receiving his S.B. degree in 1935. From the time of his employment at Crane in 1920, Mr. Kanter served in several capacities in the metallurgical laboratories from chemist to testing engineer. He was appointed assistant chief chemist and metallurgist in 1935, research metallurgist in 1937, and materials research engineer in 1941.

Mr. Kanter has been an individual member of the Society since 1937, and since that time has served on many of the Society's technical committees,

ASTM Directors

including the Joint Committee on the Effect of Temperature on the Properties of Metals, A-1 on Steel, A-3 on Cast Iron, A-7 on Malleable-Iron Castings, A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys, B-2 on Non-Ferrous Metals and Alloys, E-7 on Nondestructive Testing, and E-8 on Nomenclature and Definitions. Currently he is chairman of Committee A-1 on Steel and chairman of the Joint ASTM-ASME Committee on the Effect of Temperature on the Properties of Metals. He has served on the ASTM Chicago District Council and the ASTM Ordnance Advisory Committee. In 1929, he was awarded the ASTM Dudley Medal for researches on the creep of steel at high temperatures. In 1952, he received the Society's Award of Merit.

Mr. Kanter is the author of numerous technical papers published by ASTM and other technical societies and holds various patents on developments of a metallurgical and testing nature. He is a Fellow of the ASME, serving on its Boiler Code Subcommittee on Ferrous Metals; a member of AIME, the American Foundrymen's Assn., and the American Society for Metals. He has been active in the ASA B31 code for pressure piping and is chairman of the ASA Sectional Committee on Pipe.

DIRECTOR

Robert F. Legget, director, Division of Building Research, National Research Council, Ottawa, Canada, is a native of Liverpool, England. He was educated at the University of Liverpool, receiving his Bachelor's degree in 1925 and his Master's degree in 1927.

After four years' practical experience in Scotland and London, Mr. Legget moved to Canada in 1929 and was engaged in heavy construction work until 1936 when he joined the staff of Queen's Univ. He went on to the University of Toronto in 1938, remaining there as teacher and consultant on soil and foundation problems until 1947. He was then invited to Ottawa to start the new Division of Building Research of the National Research Council, of which he has been director since that time. He is the author of many technical papers and of two books.

Mr. Legget entered ASTM committee work in 1940 as a consulting member representative of the Department of Civil Engineering of the University of Toronto on Committee D-18 on Soils for Engineering Purposes. Later he represented the University as a full member of the committee, and since 1947 has represented the National Research Council on the committee. He is also a member of ASTM Committee D-7 on Wood as representative of Committee E-6 on Methods of Testing Building Constructions. Mr. Legget has been chairman of Committee E-6 since 1951.

He is a member of the Institution of Civil Engineers, the American Society of Civil Engineers, and the Engineering Institute of Canada. He is also a Fellow of the Royal Society of Canada and of the Geological Society of America. He was elected an Honorary Fellow of the Royal Architectural Institute of Canada in 1953.

DIRECTOR

William R. Willets is assistant manager of the Technical Service Laboratories in charge of the Paper Section of the Titanium Pigment Corp.

A native of New Jersey, Mr. Willets received his Bachelor of Science degree at the State College of Forestry, Syracuse, N. Y., in 1926. From 1926 to 1929 he was research chemist with the Oxford Paper Co.; and from 1929 until 1933, engineer, pulp insulation, for the Western Electric Co. He has been employed by the Titanium Pigment Corp. since 1933, except during a period from 1942 to 1944 when he served as a consultant to the Conservation Division of the War Production Board on pulp and paper and printing and publishing.

Mr. Willets has been a member of ASTM since 1937 and has served on ASTM Committee D-6 on Paper and Paper Products since that time. He was chairman of the committee from 1948 to 1956.

He has represented Committee D-6 on ASTM Committee E-12 on Appearance since 1946, and has been a member of ASTM Committee D-25 on Casein and Similar Protein Materials since the committee was organized in 1956. He is active on numerous subcommittees of each technical committee and was formerly a member of ASTM Committee D-9 on Electrical Insulating materials.

Mr. Willets is author or co-author of over 50 articles and monograph chapters dealing mostly with the paper industry and its technology. He is secretary-treasurer of the Society of Rheology, a member of the Governing Board of American Institute of Physics, member of the American Chemical Society, Fellow of the American Institute of Chemists, member of TAPPI (past chairman, Empire State Section, and chairman of two technical committees), member of Alpha Chi Sigma and Alpha Xi Sigma.

40- and 50-Year Members

THE SOCIETY GAVE recognition at the Annual Meeting to many of its long-term members by presenting them with 40-year and 50-year membership certificates.

50-Year Members

Charles V. Bacon
P. H. Bates
A. T. Goldbeck
A. E. Horn
William H. Klein
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G. H. Woodroffe
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Honorary Membership

The Society's Highest Honor

AN HONORARY MEMBER is a person of widely recognized eminence in some part of the field that the Society covers or one who has rendered especially meritorious service to the Society. He is elected only by unanimous vote of the Board of Directors on a letter ballot.

L. J. Markwardt, consultant, of Madison, Wis., and retired assistant director, U. S. Forest Products Laboratory, Madison, is a native of Lansing, Iowa. He received his B.S. degree in civil engineering from the University of Wisconsin in 1912, and his C.E. degree in 1922. Following service as assistant city engineer of Madison, Wis., he joined the faculty of the Engineering College of the University of Wisconsin. At the U. S. Forest Products Laboratory since 1917, he has had a leading part in important research that has advanced wood as an engineering material. He is the author of numerous technical bulletins, papers, and articles in the field of wood properties, timber design and construction, forest products utilization and methods of test, and is co-author of a textbook on descriptive geometry.

Mr. Markwardt joined ASTM in 1920, and over the years has participated in all phases of Society activities. He served as president, vice-president, and member of the Board of Directors. His services on technical committees include D-7 on Wood, serving as secretary from 1943 to 1947 and chairman from 1948 to 1960; Committee D-10 on Shipping Containers; E-1 on Methods of Testing; E-6 on Methods of Testing Building Constructions, serving as chairman from 1946 to 1948; C-19 on Structural Sandwich Constructions; C-20 on Acoustical Materials; D-20 on Plastics; E-10 on Radioisotopes and Radiation Effects; and D-23 on Cellulose and Cellulose Derivatives. He has also served for several years on the Chicago District Council.

Mr. Markwardt is chairman and has served for many years on ASA Sectional Committee A14 on Safety Code for Construction, Care and Use of Ladders. He is a member of ASA Sectional Committee 05 on Specifications for Wood Poles, and is a member of the ASA Construction Standards Board. He has served as a member of the Building Research Advisory Board and presently is a member of the Materials Advisory Board of the National Academy of Sciences–National Research Council.

Known internationally as an authority on forest products and their use, he is currently chairman of the U. S. program committee for technical forest products for the 5th World Forestry Congress to be held at Seattle this year. He has represented the Forest Products Laboratory and the United States at a number of international conferences and has been a member of the Timber Research Committee of the International Union of Forest Research Organizations and of the Committee on Mechanical Wood Technology of the Food and Agriculture Organization of the United Nations. In 1943, Mr. Markwardt was honored by ASTM as the Edgar Marburg Lecturer. His subject was "Wood as an Engineering Material." The U. S. Department of Agriculture in 1957 conferred upon him a superior service award. In 1950, the University of Wisconsin gave him its Distinguished Alumnus Citation.

Other societies in which Mr. Markwardt holds membership are ASCE, AREA, the Society of American Foresters, NSPE, AAAS, Tau Beta Pi, Sigma Xi, and Chi Epsilon.

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40-Year Members

(Continued)

California State Department of Public Works, Division of Architecture
Chase Brass and Copper Co., Inc.
Cities Service Oil Co.
Connecticut State Highway Dept.
Consolidated Edison Company of New York, Inc.
Cook Paint and Varnish Co.
Cornell University, School of Chemical Engineering
Ray B. Crepps
Herbert A. Davis
Drexel Institute of Technology
John R. Dwyer
J. V. Emmons
John R. Freeman, Jr.
General Steel Castings Corp.
James P. Gill
L. T. Holt
Idaho State Department of Highways
D. W. Kessler
Thomas C. Law
Louisville Cement Co.
The Mansfield Tire and Rubber Co.
L. J. Markwardt
Massachusetts Institute of Technology
Minnesota Department of Highways
Mississippi State Highway Dept.
Norman L. Mochel
Benjamin Moore and Co.
R. R. Moore
National Malleable and Steel Castings Co.
New Hampshire Department of Public Works and Highways
New York City, Department of Purchase
Gershon L. Oliensis
Omaha, City of, Department of Public Works
Arthur Phillips
Pittsburgh Plate Glass Co.
The Richardson Co.
Riverton Lime and Stone Co., Inc.
Saskatchewan, University of, Library
Sun Shipbuilding and Dry Dock Co.
Sydney, University of, Fisher Library
Union Carbide Metals Co., Division of Union Carbide Corp.
Universal-Cyclops Steel Corp.
Virginia, Commonwealth of, Department of Highways
Stanton Walker
E. H. Wellemeyer
The West Virginia State Road Commission
Western Brass Mills, Metals Division of Olin Mathieson Chemical Corp.
The S. S. White Dental Manufacturing Co.
The Woodville Lime Products Co.
Frank W. Yeager

Awards of Merit

NINETEEN LEADERS in the field of engineering materials—men who have rendered outstanding service to the American Society for Testing Materials, particularly in its technical committee work, were honored at the President's Luncheon with Awards of Merit.

Under the rules governing the Award of Merit, each technical committee may suggest one candidate annually, and the Award Committee may select nominees from other areas of the Society's work as well. While each of the award winners listed below was honored for intensive work and contributions in a specific technology, each has furthered in numerous ways the general activities of the Society.

To **Leslie H. Adam,** *deputy chief, Engineering Support Div., Pitman-Dunn Laboratories Group, Frankford Arsenal, Phila., Pa., in recognition of outstanding service and contributions to ASTM research and standards work, especially in Committees B-7 on Light Metals and Alloys, Cast and Wrought, and B-5 on Copper and Copper Alloys, Cast and Wrought.*

Born in East Bridgewater, Mass., Leslie H. Adam received his B.S. in chemical engineering from Northeastern University in 1936. During his undergraduate years he was also a metallurgical observer with the Hunt-Spiller Manufacturing Corp. His training in the metal field continued while with the foundry division of the York Ice Machinery Corp. Later he became a metallurgist with the York Safe and Lock Co. In 1940 his deep interest in ASTM started when he joined the staff at Frankford Arsenal, Philadelphia, Pa. Since then he has worked with the non-ferrous metal committees of the Society, being a member of Committee B-2 on Non-Ferrous Metals and Alloys, B-5 on Copper and Copper Alloys, and B-7 on Light Metals and Alloys. He has served on many task groups studying standards and test methods for ASTM and the U. S. Government.

For the past four years he has been secretary of Committee B-5, a member of the Executive Committee, and a representative on the Coordinating Committee on Non-ferrous Metals and Alloys. He is a member of the Advisory Committee of Committee B-7, acting as its representative to the Advisory Committee on Corrosion, and serving as chairman of Subcommittee VIII on Atmospheric Exposure. Many of his technical papers on the atmospheric exposure of lightweight metals appear in the ASTM *Proceedings*, as a part of Committee B-7 research on materials. In June, 1958, he represented the United States at the Harrogate, England, meetings of ISO/TC26 on Copper and Copper Alloys and ISO/TC79 on Lightweight Metals and Alloys.

To **Frank M. Clark,** *consulting engineer on Insulation, General Electric Co., Schenectady, N. Y., in recognition of sustained and outstanding leadership first in Committee D-9 on Electrical Insulating Materials, and subsequently in the newly organized Committee D-27 on Electrical Insulating Liquids and Gases.*

Frank M. Clark, a native of Peekskill, N. Y., received his B.S. (with highest honors) and M.S. degrees in 1917 and 1918, respectively, from Wesleyan Univ., and took additional graduate work at Yale and Princeton. His professional career has included instructorships at Wesleyan Univ., Allegheny College, Princeton Univ., and Lafayette College. Since 1923 he has been associated with General Electric Co. where the bulk of his work has been in the fields of high-voltage dielectrics, electrolytic phenomena, petroleum, oxidation, and organic synthesis.

Since 1927, Mr. Clark has represented his company on Committee D-9 on Electrical Insulating Materials and later Committee D-27 on Electrical Insulating Liquids and Gases, which for the past year he has headed as chairman. For seven years he served as chairman of Subcommittee IV on Liquid Insulation of Committee D-9, before it was reorganized as Committee D-27. He was vice-chairman of Committee D-9 from 1956 to 1958 and has served on a number of its subcommittees. He has been on the New York District Council since 1956.

Active in several technical societies, Mr. Clark is a Fellow of the AIEE and the American Institute of Chemists; a member of the American Electrochemical Society (past director); American Chemical Society; and since 1952 the American representative on dielectric liquids to the International Congress for High Voltage Research. Since 1948 he has been American advisor on insulating liquids to the International Electrochemical Commission. Mr. Clark has received the Coffin Award three different times, 1932, 1934, and 1950. He is a member of Phi Beta Kappa.

To **Harold F. Clemmer,** *engineer of materials and standards, District of Columbia Highway Dept., Washington, D. C., in recognition of long and effective services to the Society in technical committee, district, and administrative activities, and especially for work in Committee D-4 on Road and Paving Materials, and other technical committees.*

Harold F. Clemmer, a native of Hampton, Iowa, received his B.S.-C.E. from Iowa State College in 1912 and his C.E. degree in 1918. He was associate professor of civil engineering at Iowa State College from 1912 to 1918 and engineer of materials for the State Highway Department of Illinois from 1920 to 1926. Later he was a technical adviser to the Solvay Process Co., and in 1929 became engineer of materials for the District of Columbia Highway Dept. His professional career has included work in the design of rigid-type pavements, earth pressure on pipes in ditches, fatigue and curing of concrete.

Mr. Clemmer has been a member of the Society since 1915, and has been active in Committee D-4 on Road and Paving Materials since 1922. He has served on numerous subcommittees, being active on the D-4–D-18 Joint Subcommittee on Stabilized Soils for 16 years. A member of Committee C-9 on Concrete and Concrete Aggregates for 36 years, he has served as chairman of three of its subcommittees for varying periods. Since 1936, Mr. Clemmer has been a representative of Committee C-9 on the Standing Committee in Charge of Simplified Practice Recommended for Coarse Aggregates of U. S. Department of Commerce. He has also served on Committee A-1 on Steel for 25 years, Committee C-1 on Cement for 19 years, and Committee D-18 on Soils for Engineering Purposes for 22 years, being chairman for three years, a member of the Executive Committee, and three of its subcommittees for varying periods of time. For many years Mr. Clemmer was a member of ASA Sectional Committee A37 on Road and Paving Materials. His ASTM administrative activities include membership on the Board of Directors from 1937 to 1939. From 1937 to 1954 he was a member of the Washington, D. C., District Council and served as chairman for three years.

To **O. B. Ellis,** *senior research engineer, Armco Steel Corp., Research Laboratories, Middletown, Ohio, in recognition of long-time leadership and significant contributions to the activities of Committee A-5 on Corrosion of Iron and Steel, A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys, B-3 on Corrosion of Non-Ferrous Metals and Alloys, and the Advisory Committee on Corrosion.*

O. B. Ellis is a graduate of the University of Louisville, receiving his B.S. in chemistry in 1922, and his M.S. in physics in 1924. From 1924 to 1929, he taught school in Somerset, and Ashland, Ky., after which he became affiliated with the American Rolling Mill Co., now Armco Steel Corp., as a special chemist. In 1932 he moved to the company's research laboratories in Middletown, Ohio, later becoming assistant chief chemist. He has been in the Armco Corrosion Laboratory since 1941.

Since 1943, Mr. Ellis has been a member of Committee A-5 on Corrosion of Iron and Steel. He has been on five of its subcommittees, serving as chairman of Subcommittee VII on Methods of Testing for seven years. Presently he is working on specifications for coating thickness of aluminum-coated steel and is actively contributing to the work of a task group responsible for a new metallic-coated sheet test.

His other committee activities include 14 years on Committee B-3 on Corrosion of Non-Ferrous Metals; 17 years on Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys, including three years as chairman of Subcommittee IV on Methods of Corrosion Testing; and seven years as member-at-large on the Advisory Committee on Corrosion.

To **Charles M. Gambrill,** *analytical coordinator, Research Laboratories, Ethyl Corp., Detroit, Mich., in recognition of long-time active participation in ASTM work, notably in Committee D-2 on Petroleum Products and Lubricants, and for services in administrative and district work.*

Mr. Gambrill received his B.S. degree from the University of Maryland in 1924, and was employed as a chemist by the Hagen Corp. in Pittsburgh, Pa., and later as assistant works chemist by Mathieson Alkali Works, Inc., in Niagara Falls, N. Y. He has been associated with the Ethyl Corp. for 32 years and since 1954 has been analytical coordinator in the Research Laboratories. He joined the company in 1928 as an analyst, became head of the Analytical Section in 1936, and in 1952 became manager of analytical research and services.

A member of the Society since 1945, he currently represents Ethyl Corp. on Committee D-2 on Petroleum Products and Lubricants. His greatest service to the Society and Committee D-2 stems from his chairmanship of Research Division III on Elemental Analysis since 1949. Under his guidance, Research Division III has not only maintained existing ASTM standards but has developed a whole series of new methods. An expert on additives in fuels, he has served on and given assistance to the large technical committees on diesel fuels and gasolines. He represented Committee D-2 on Subcommittee 15 of Committee E-1 on Methods of Testing and was a member of Committee E-2 on Emission Spectroscopy, both for ten years. He also served on Committees E-13 on Absorption Spectroscopy, E-14 on Mass Spectrometry, and E-15 on Analysis and Testing of Industrial Chemicals.

His administrative service has included a ten-year term on the Administrative Committee on District Activities, of which he was chairman from 1951 to 1958. He also served for 15 years on the Detroit District Council, being secretary from 1948 to 1950.

During recent years, Mr. Gambrill has served as chairman of the Anachems, having received the ANACHEM Award in 1958 for his extensive contributions in the field of analytical chemistry. He is also active in ACS and is currently serving on the API Committee on Analytical Research.

To **George R. Gohn,** *supervisor, Mechanical Testing Laboratory, Bell Telephone Laboratories, Inc., New York, N. Y., in recognition of long-time active participation in ASTM work, especially in the field of non-ferrous metals and particularly in Committee B-5 on Copper and Copper Alloys, Cast and Wrought, and for support of ASTM administrative and district work.*

George R. Gohn is a native of Dayton, Ohio. He was graduated from Otterbein College in 1926, and in 1929 received a B.S. in engineering and the degree of Metallurgical Engineer from Columbia Univ., starting with Bell Telephone Laboratories the same year.

He has been a member of ASTM since 1936. An expert on the use of non-ferrous metals, Mr. Gohn has served on Committee B-5 on Copper and Copper Alloys, Cast and Wrought, for 22 years. Numerous subcommittees have benefited from his services, especially Subcommittee G-1 on Methods of Test of which he was chairman for eleven years. Other technical committee activities include 17 years on Committee B-2 on Non-Ferrous Metals and Alloys; 15 years on Committee B-6 on Die-Cast Metals and Alloys; twelve years of service to Committee E-1 on Methods of Testing; and twelve years on Committee E-9 on Fatigue.

Mr. Gohn served as a director of the Society from 1952 to 1955. He was a member of the Administrative Committee on Papers and Publications from 1945 to 1954. He has written numerous papers on properties of metals, creep, and fatigue testing and was the co-author of the *Manual for Authors of ASTM Papers.* For six years he has served in the New York District Council and was chairman of the Technical Program Committee for the 50th Anniversary Meeting in 1952.

To **William N. Harrison,** *chief, Enameled Metals Section, National Bureau of Standards, Washington, D. C., in recognition of valued and intensive effort in the work of Committee C-22 on Porcelain Enamel, and for leadership as chairman of the committee since its organization.*

William N. Harrison is a native of Tunstall, Va. He received his B.S. degree from Virginia Polytechnic Inst. in 1920, and his M.S. in chemistry from the University of Chicago in 1921. He has worked in the Enameled Metals Section of the National Bureau of Standards since 1922, becoming chief of the section in 1936. Mr. Harrison has made numerous contributions to work on high temperature ceramic coatings and to development of new tests and apparatus for evaluating porcelain enamels, and has published numerous articles in this field. He received the Department of Commerce award for leadership in pioneer development of ceramic coatings for high-temperature protection of steels. His work has included the study of the use of radioactive and stable isotopes in the mechanism of adherence and the relation between composition and properties of porcelain enamels.

Mr. Harrison has been a member of ASTM since 1945. In 1949 he was instrumental in founding Committee C-22 on Porcelain Enamel and since then has been the wellspring of the active, progressive spirit among its members, serving as chairman since the committee's organization. Other Society committee activities include six years as representative of Committee C-22 on the Advisory Committee on Corrosion and membership on Committee E-10 on Radioisotopes and Radiation Effects.

Mr. Harrison is a Fellow of the American Ceramic Society (past-chairman Enamel Div., Standards Committee, and Baltimore-Washington Section), Washington Philosophical Society, Washington Academy of Sciences, ASM, and the Porcelain Enamel Institute Quality Development Committee. He formerly was a member of the National Advisory Committee for Aeronautics' Subcommittee on Heat-Resistant Materials and a

Awards of Merit

member of the Guided Missile Materials Panel of the Materials Advisory Board, National Academy of Sciences.

To **Milton E. Holmberg,** *metallurgical consultant, Houston, Tex., in recognition of intensive activity and service in many phases of ASTM work, notably in district activities and inter-society cooperation, and for work in the field of corrosion.*

Milton E. Holmberg is from Pennsylvania, where he was graduated in metallurgical engineering from Pennsylvania State College in 1931. Following graduation, he worked for Black, Sivalls & Bryson, Inc., in Oklahoma City as metallurgical and welding engineer. In 1936, he moved to Bartlesville, Okla., where he was employed by Phillips Petroleum Co. His work included the application of materials, checking fabrication details, inspection and testing of equipment, setting up welding procedures for use in refineries, and investigating materials and equipment failures. To aid in this work, he was instrumental in establishing his company's metallurgical and mechanical testing laboratory. Since July, 1951, he has been a metallurgical consultant to the oil and petrochemical industries in the Houston area. He became active in ASTM committee work in 1944 when he became the Phillips Petroleum Co. representative on Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys. He presently represents the National Association of Corrosion Engineers on A-10, and on Committee D-19 on Industrial Water. Mr. Holmberg also represents ASTM on the Joint Liaison Committee on Corrosion. He became an individual member of the Society in 1951.

Mr. Holmberg has been a member of the Southwest District Council for seven years and chairman for two years. In addition, he has headed a special corrosion committee for the Southwest District Council, overseeing the installation of specimens and general maintenance of the Freeport, Tex., exposure test site.

He is an active member of AMS, NACE, AWS, and API.

To **Lester E. Kuentzel,** *senior research chemist, Wyandotte Chemicals Corp., Wyandotte, Mich., in recognition of outstanding service in the development and publication of the ASTM-Wyandotte system for coding spectral data on IBM punch cards under the auspices of Committee E-13 on Adsorption Spectroscopy.*

Lester E. Kuentzel was born in Fort Worth, Tex., and received his Ph.D. degree in physical chemistry from the University of Colorado in 1941. He then joined the staff of the Research Department at Wyandotte Chemicals Corp., where he has served as head of the Physical Measurements Section and the Physical Analytical Laboratories. He participated in the Free Radicals Research Project at the National Bureau of Standards as a guest scientist during 1957. He is currently engaged in basic research in the area of low-temperature free radical chemistry as a senior research chemist at Wyandotte.

His research and publication activities have covered such subjects as the properties of detergent solutions, specialized paint removers (six patents), X-ray diffraction, electron microscopy, infrared spectroscopy, and low-temperature chemistry. Efforts of particular interest to ASTM were directed toward the development of a system for indexing infrared spectral data and chemical structure into punched cards for machine assistance in qualitative analysis and structure correlation. The indexing system was expanded to include X-ray diffraction, ultraviolet, visible and near infrared data, and has become known as the Wyandotte-ASTM Punched Card Index. The spectral absorption index is sponsored by Committee E-13 on Absorption Spectroscopy, and the X-ray diffraction index by the Joint Committee on Chemical Analysis by Powder Diffraction Methods.

Mr. Kuentzel has been a member of ASTM since 1950, and has served as vice-chairman of Committee E-13 on Absorption Spectroscopy for four years. He has been active also on Committee E-4 on Metallography and its Subcommittee on X-ray Methods.

His activities outside ASTM include membership in the American Chemical Society, The American Optical Society, the American Physical Society, and the Association of Analytical Chemists. He also serves as a member of two National Research Council committees.

To **Stuart M. Phelps,** *director of research and tests, Refractories Fellowship, Mellon Institute of Industrial Research, Pittsburgh, Pa., in recognition of distinguished and constructive leadership in the technical work of Committee C-8 on Refractories, and for administrative support as secretary and vice-chariman of this committee.*

Stuart M. Phelps was born in Rochester, N. Y., attended the public schools there, and later attended the Brantford (Ontario) Collegiate Inst. He showed an early interest in scientific work, and at the age of twenty was appointed to the Fertilizer Fellowship at Mellon Inst., Pittsburgh. After ten months, in March, 1918, he was transferred to the Refractories Fellowship as Fellowship assistant. In July, 1926, he became Senior Fellow and holds that position at the present time. His Fellowship is maintained by the Refractories Inst., for which he is now director of research and tests. Since 1925, he has been secretary of the Technical Advisory Committee of that Institute.

Mr. Phelps has been a member of ASTM since 1923, and has served on Committee C-8 on Refractories for 33 years. From 1936 to 1948 he was secretary, and from 1956 has been vice-chairman of the committee. He has also been on numerous subcommittees and has been chairman of Subcommittee II on Research and Subcommittee III on Tests.

In a surprise ceremony at the President's Luncheon, Miss Marie A. Ounan, secretary to the Board of Directors, is presented with an orchid corsage by President F. L. LaQue in recognition of her 40 years of service to the Society. Past-President Richard T. Kropf looks on approvingly.

In addition to his work with ASTM, he is active in the American Ceramic Society, being a trustee since 1949.

Mr. Phelps' work at Mellon Inst. has included investigations of many refractory materials and products, resulting in six patents and 80 technical papers, most of which appeared in American Ceramic Society or Refractories Institute publications.

To **Harry C. Plummer,** *director of engineering and technology, Structural Clay Products Inst., Washington, D. C., in recognition of long-time constructive participation in the work of ASTM building materials committees, especially C-7 on Lime, C-12 on Mortars for Unit Masonry, and C-15 on Manufactured Masonry Units, and for promoting the use of ASTM standards by architects and engineers.*

A native of West Union, Ohio, Harry Plummer received his A.B. from Ohio Univ. in 1918, and his B.S. from Case Institute of Technology in 1923. After being president and general manager of the Sterling Engineering Co. from 1925 to 1934 he became chief engineer for the Brick Manufacturing Assn. until 1937. This same year he became associated with the Structural Clay Products Inst. and at the present time is director of engineering and technology. Prior to his employment by the Structural Clay Products Inst., the products of that industry were not standardized. Now, largely as a result of his leadership, ASTM standards are being recommended and used by the members of the institute. He has also been a leader in the formulation of improved building codes for masonry construction in which the requirements for materials are covered by ASTM standards.

Mr. Plummer's service to ASTM has included 22 years of membership on Committee C-12 on Mortars for Unit Masonry, being vice-chairman for eight years and secretary for 14 years. He has also served on Committee C-15 on Manufactured Masonry Units for 22 years and many of its subcommittees, and for 21 years has been a member of Committee C-7 on Lime. In addition to this, he has been a member of Committee E-6 on Methods of Testing Building Constructions and has been chairman both of Subcommittee IV on Unit Masonry and Subcommittee IX on Masonry. Mr. Plummer has also served on Committee D-4 on Road and Paving Materials. In addition to his work on technical committees, Mr. Plummer has served as member of the Washington, D. C., District Council for two years.

He is a member of ASCE, American Standards Assn., American Concrete Inst., and is a Fellow in the American Ceramic Society.

To **Orin W. Rees,** *head, Section of Analytical Chemistry, Illinois State Geological Survey, Urbana, Ill., in recognition of long-time meritorious service to ASTM in support of research and standardization, especially as a member and officer of Committee D-5 on Coal and Coke.*

Dr. Rees is a native of Illinois. He received the B.S. degree in chemistry from Earlham College in 1922, and the M.S. and Ph.D. degrees in chemistry from the University of Illinois in 1925 and 1931, respectively.

From 1922 to 1924, he was instructor in chemistry at Earlham College, and from 1925 to 1930 he served as analyst for the Illinois State Water Survey. In 1931 he accepted the position of head of the Analytical Chemistry Section at the Illinois State Geological Survey, which position he still holds.

Dr. Rees joined the ASTM in 1936 and has been an active member of Committee D-5 on Coal and Coke since that time. He has served as member and chairman of various subcommittees and for the past four years he has served as chairman of Committee D-5. In addition, he has represented Committee D-5 in Research Division III of Committee D-2 on Petroleum Products and Lubricants and in Subcommittees XIII and XV of Committee D-1 on Paint, Varnish, Lacquer, and Related Products.

He has been active in international standardization work and has attended, as an American delegate, three meetings of Technical Committee 27 on Solid Mineral Fuels, of the International Organization for Standardization held in London (1953), Stockholm (1955), and Harrogate, England (1958). At the Harrogate meeting he was leader of the American delegation.

Dr. Rees is a member of the American Chemical Society, Illinois State Academy of Science, Illinois Mining Inst., and others. He is a Fellow of the American Association for the Advancement of Science and is the author or co-author of some 40 published reports having to do primarily with properties of mineral resources and methods for analysis.

63rd Annual Meeting

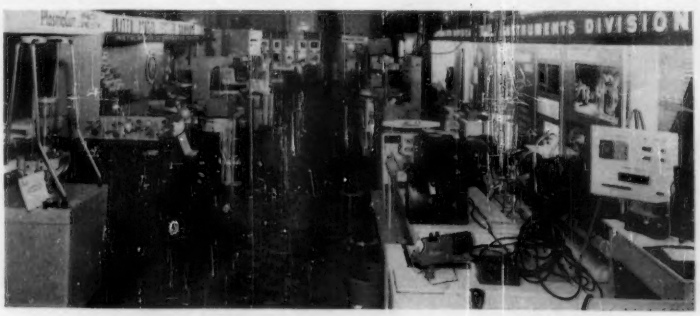
To **William A. Reich,** *manager, Engineering Section, Metallurgical Products Dept., General Electric Co., Detroit, Mich., in recognition of outstanding leadership as chairman in organizing and directing the work of Committee B-9 on Metal Powders and Metal Powder Products during the early years of the committee.*

William A. Reich has been manager —engineering of the Metallurgical Products Dept. for the General Electric Co. in Detroit, Mich., since 1958. He has responsibility for all Carboloy cemented carbide engineering operations including engineering administration, advance product engineering, product design and evaluation engineering, and special powder metallurgical projects.

After receiving his B.S. degree from Carnegie Institute of Technology in 1938, he joined General Electric Research Laboratory, Schenectady, N. Y. The following year he was transferred to the Schenectady Works Laboratory where he specialized in high-temperature alloys and non-ferrous casting. During the war years, he taught defense courses in metallurgy at Rensselaer Polytechnic Inst. and Union College. In 1945, he was appointed head of the Metallurgical Section of the Schenectady Works Laboratory and in 1953 was assigned to the Metallurgical Products Dept. as manager —advance product engineering.

Mr. Reich has been a member of the Society since 1946, and has served as chairman of Committee B-9 on Metal Powders and Metal Powder Products for nine years. In addition, he has been active on Committee E-5 on Fire Tests of Materials and Construction.

Besides his activities in ASTM, Mr. Reich is a member of the AIME, the American Ordnance Assn., ASM, and the Metal Powder Industries Federation.



VIEW OF APPARATUS EXHIBIT SHORTLY BEFORE OPENING.

Awards of Merit

To **Charles H. Scholer,** *head, Department of Applied Mechanics, Kansas State College, Manhattan, Kan., in recognition of many years of sustained productive service in ASTM technical committee work, especially as a member of Committee C-1 on Cement, Committee C-9 on Concrete and Concrete Aggregates, and Committee D-4 on Road and Paving Materials.*

Charles H. Scholer, a native of Kansas, received his B.S. in civil engineering from Kansas State Univ. in 1914. The following year he worked at the U. S. General Land Office, Santa Fe, N. M. From 1917 to 1918 he was with the Artillery Ammunitions Section, Army Ordnance Corps, Washington, D. C., and then became engineer of tests in the Road Materials Laboratory, Kansas State Univ., serving until 1929. From 1923 until 1956, he was professor and head of the Applied Mechanics Dept. at Kansas State Univ.

Prof. Scholer has been an individual member of ASTM or the official representative of the Road Materials Laboratory of Kansas State Univ. for more than 40 years, and has been active in ASTM committee work for over 35 years, serving on Committees C-1 on Cement, C-9 on Concrete and Concrete Aggregates, C-12 on Mortars for Unit Masonry, D-4 on Road and Paving Materials, and E-1 on Methods of Testing. He has served on a number of special committees of the Society, including the Nominating Committee, the Sanford E. Thompson Award Committee, and the Frank E. Richart Award Committee.

In addition to ASTM, Mr. Scholer has been active in a number of professional and technical societies, being a life member of ASCE and Kansas Engineering Society; he is also a member of ASEE, NSPE, and is an honorary member and past-president of ACI. He has served as a consultant on concrete and concrete materials problems for many private and governmental organizations, including the Portland Cement Assn., the U. S. Army Corps of Engineers; the U. S. Bureau of Reclamation; the TVA; the U. S. Navy, Bureau of Yards and Docks; and numerous state highway departments.

To **Walter S. Scott,** *metallurgist, Republic Steel Corp., Cleveland, Ohio, in recognition of outstanding service in the development of standards in Committee A-1 on Steel and for valued contributions to the work of administrative committees.*

Walter S. Scott was born in East Liverpool, Ohio, and was graduated from Carnegie Institute of Technology in 1914. Since then he has been employed continuously at Republic Steel Corp. and for many years has been the official representative of his company's sustaining membership in ASTM.

Since 1950, he has been a member of Committee A-1 on Steel and four of its subcommittees. Other committee activity includes ten years of membership on Committee A-5 on Corrosion of Iron and Steel. In addition, Mr. Scott has coordinated his company's representation in other ASTM Committees.

His administrative activity has included nine years of membership on the Cleveland District Council and membership in the Technical Committees Activities Group of the Long Range Planning Committee.

Mr. Scott is a member of ASA, SAE, the Industrial Fasteners Inst., Technical Committee on Carbon Bars, and the Editorial Committee of AISI.

To **Louis Tanner,** *chief chemist, United States Customs Laboratory, Boston, Mass., in recognition of active, creative, and continuing contributions to the advancement of evaluation of quality, particularly in Committees D-13 on Textile Materials and E-11 on Quality Control of Materials.*

Louis Tanner received a B.S. degree from the City College of New York, and an S.M. degree in chemistry from Massachusetts Institute of Technology. He later did postgraduate work at Columbia Univ. in chemical engineering.

An employee of the Bureau of Customs since 1926, Mr. Tanner is chief chemist and director of the Bureau's laboratory at Boston, Mass., which analyzes and tests a variety of imported products and materials. In 1939, he established a wool sampling and testing laboratory at Boston, that has served as a model adopted by industry both here and abroad. He has conducted numerous studies on the accuracy and precision of test methods and on the sampling of materials, and has contributed to the application of statistics to these and related fields. He is the inventor of many devices useful in sampling and testing, and in 1950, received the Government's Award for Exceptional Civilian Service.

Mr. Tanner has been a member of the Society since 1946, and has been active on Committee D-13 on Textile Materials for 20 years and many of its subcommittees for varying periods of time. He is also a member of Committee E-11 on Quality Control of Materials and has headed Task Group 8 on Empirical Data for five years. In addition, he is a member of Committee E-16 on Sampling and Testing of Metal-Bearing Ores and Related Materials, and presently is chairman of Subcommittee II on Sampling of Bulk Materials. He has been a member of the New England District Council for two years and has written numerous technical papers.

To **Robert R. Thurston,** *consultant (retired assistant manager, Technical Service Division of Research and Technical Dept., The Texas Company), Jenson Beach, Fla., in recognition of generous contribution of extensive professional engineering knowledge to the development of specifications and methods of test in Committee D-8 on Bituminous Materials for Roofing, Waterproofing, and Related Building or Industrial Uses, and its other technical committees.*

A native of Chicago, Mr. Thurston received his early education there and in Hackensack, N. J. Massachusetts Institute of Technology awarded him the B.S. degree in chemical engineering in 1922.

He was employed by Bird & Son, Inc., in Chicago, and by Procter & Gamble, in Ohio, before joining the Texas Company as a chemical engineer in the Technical Div. of the Refining Dept. in New York City in 1929. In 1931, he was transferred to Beacon to set up the Asphalt Research Dept. He returned to Technical and Research Division Headquarters in New York in 1933, and in 1938 was named supervisor of asphalt and roofing. He became assistant director of technical services in 1943 and served as assistant manager from the time of the formation of the Research and Technical Dept. in 1954 until his retirement in 1958.

Mr. Thurston joined the Society in 1939, and since then has been a member of Committee D-4 on Road and Paving Materials. He has served as chairman of Subcommittee B-6 on Extraction and Recovery of Constituents from Bituminous Mixtures and chairman of Subcommittee 17 on Emulsion Tests. He has also served on numerous other subcommittees. Mr. Thurston's service to the Society has not been confined to the work of Committee D-4. He was long a member of Committee D-8 on Bituminous Roofing and Waterproofing Materials, serving on the Advisory Committee for many years, as chairman of Subcommittee I on Nomenclature, Definitions, and Editorial, and also on a number of subcommittees. He has been a member of

Committee D-18 on Soils for Engineering Purposes, and Committee D-2 on Petroleum Products and Lubricants, also serving on many of their subcommittees.

His contribution to asphalt technology extends far beyond his work in ASTM. He is active in eight other technical societies, including the National Research Council, American Railway Engineering Assn., and Association of Asphalt Paving Technologists.

To **Stanton Umbreit** *(retired metallurgist, Tube Div., Radio Corporation of America, Harrison, N. J.), West Orange, N. J., in recognition of active and constructive service in practically every venture of Committee F-1 on Materials for Electron Tubes and Semiconductor Devices, and long-time service on Committee B-4 on Metallic Materials for Electrical Heating, Electrical Resistance, and Electrical Contacts, having served as secretary of both committees for five years.*

Stanton Umbreit has headed the metallurgy section of RCA Victor's development work on receiving and transmitting tubes for radio and television for the past 23 years. Born in Milwaukee, Wis., he received his degree in chemical engineering in 1916 from the University of Wisconsin. His first job was with the Newport Chemicals Co. on development of dyestuffs to offset the loss of German imports during World War I, as well as dye intermediates, phenols, and explosives. After a year he returned to the University of Wisconsin for a year of graduate study and taught classes in chemical engineering and metallography. In 1918 he started with the National Lamp Co., Cleveland, first as a chemist and later as a metallurgist. Later he worked for Electron Relay Co., Toledo, and from 1925 to 1929 did developmental work on radios, tube testers, and various power supply units for the Sterling Mfg. Co. His career with RCA began in 1930 when he joined the radio tube division where his work involved the chemical, physical, and metallurgical development of radio receiving parts and transmitting tubes. In 1950 he was made manager of the Chemical Physical Laboratory at Harrison, N. J.

Mr. Umbreit has been a member of ASTM since 1939 and has been a member of Committee F-1 on Materials for Electron Tubes and Semiconductor Devices since it was organized five years ago. He has also been active on Committee B-4 on Metallic Materials for Electrical Heating Contacts, being chairman for five years, and serving on Subcommittee IV on Contact Materials, Subcommittee VIII on Metallic Materials for Radio Tubes and Incandescent Lamps, and other subcommittees. For nine years he has been a member of Committee E-1 on Methods of Testing, representing Committee B-4 on Subcommittee XII on Methods for Density.

To **James S. Vanick**, *consultant (retired metallurgist, the International Nickel Co., Inc., New York, N. Y.), Sea Girt, N. J., in recognition of outstanding and sustained service in ASTM technical work, especially the support of Committee A-3 on Cast Iron of which he was chairman for five years, and for many years of district activities.*

James S. Vanick received his B.S. in metallurgical engineering from Case Institute of Technology and his M.S. degree from George Washington Univ. After graduation he became associated with the British Ministry of Munitions as engineer of tests until 1917. Next he became a research associate in metallurgy at the National Bureau of Standards for the U. S. War Department on problems of armor-piercing shot, armor plate, machine-gun erosion, and nitrogen fixation equipment. From 1922 until his retirement this year, Mr. Vanick has been associated with the International Nickel Co., Inc., as a metallurgist in the Foundry Products Div. Since his retirement, he has been occupied with consulting work.

Mr. Vanick has been a member of ASTM since 1918, and for 26 years has been a member of Committee A-3 on Cast Iron, serving as chairman from 1949 to 1954. Numerous subcommittees have benefited from his service. He was a representative of Committee A-3 on Subcommittee VII of Committee E-8 for 13 years, and on Committee E-1 on Methods of Testing for 14 years. For twelve years he has been active on Committee B-5 on Copper and Copper Alloys, Cast and Wrought, and several of its subcommittees. He has been a member of Committee E-7 on Nondestructive Testing, Committee B-2 on Non-Ferrous Metals and Alloys, the Advisory Committee on Corrosion, and the Joint Committee on Definitions of Terms Relating to Heat Treatment of Metals. He has also served on the New York District Council for twelve years.

Mr. Vanick is active in the American Foundrymen's Society, AIME, ASM, NACE, ANS, ASME, The British Iron and Steel Inst., and the British Institute of Metals. He has been honored by a citation from the Gray Iron Founders' Society, and was the recipient of the AFS McFadden Gold Medal in 1956. Numerous papers and articles on metallurgical subjects are to his credit, as well as the invention of the Ni-Hard family of abrasion and the Ni-Resistant type of corrosion-resistant cast irons.

FIFTY-YEAR MEMBERS RECOGNIZED AT PRESIDENT'S LUNCHEON

Four of those who were recognized as 50-year members of the Society at the President's Luncheon on Tuesday, June 28. Left to right: E. B. Gebert, representing The Western Union Telegraph Co.; J. M. Wendling, representing the City of St. Louis, Municipal Testing Laboratory; Paul Rilzdeposki, representing The Studebaker-Packard Corp.; and W. H. Klein, individual member.

FORTY-YEAR MEMBERS RECOGNIZED AT PRESIDENT'S LUNCHEON

Medals and Awards

Research in Engineering Materials

CHARLES B. DUDLEY MEDAL

This medal was established by voluntary subscriptions from the members as a means of stimulating research in materials and of recognizing meritorious contributions to its publications, at the same time commemorating the first president of the Society, whose inspiring leadership has had a profound influence on its development.

• 1960 award to **G. R. Irwin, J. A. Kies,** and **H. L. Smith** for their paper, "Fracture Strengths Relative to Onset and Arrest of Crack Propagation," which was published in the ASTM *Proceedings*, Vol. 58 (1958).

George Rankin Irwin is a native of El Paso, Tex. He was educated at Knox College (A.B. 1930) and the University of Illinois (A.M. 1933, Ph.D. 1937). At the University of Illinois, he was a graduate assistant in physics from 1931 to 1935, and then was assistant professor at Knox College for a year. In 1936 and 1937 he held a fellowship at the University of Illinois.

After receiving his Ph.D. he joined the staff of the Naval Research Laboratory as physicist in 1937, becoming associate superintendent in 1947 and superintendent of the Mechanics Div. in 1950, the position he now holds. He has specialized in band spectroscopy, armor, projectile penetration, high-strength materials, deformation and fracturing of solids, and structural reliability in rockets. He is a member of Sigma Xi and the American Physical Society.

Joseph Arthur Kies, a native of LeRoy, Ill., received his B. S. and M.S. degrees from the University of Illinois in 1931 and 1933, respectively. After serving as a teaching assistant in physics at Illinois from 1931 to 1935, he joined the staff of the National Bureau of Standards as junior physicist and became metallurgist in 1936. In 1944 he became engineering physicist at the Western Region Research Laboratory of the U. S. Department of Agriculture. In 1937 he became senior metallurgist at the Oak Ridge National Laboratory, returning to the Naval Research Laboratory as metallurgist in 1948. Since 1952 he has been a physicist at the NRL. Mr. Kies' studies have included fracture mechanics in metals, plastics, and glass, and structural reliability in rockets.

He is a member of ASTM, ASM, the American Physical Society, The Society of Plastics Engineers, Physical Society of Japan, Washington Philosophical Society, and Sigma Xi.

Herschel LeRoy Smith, Jr., is a native of Oklahoma City, Okla. He received his education at Oklahoma City Junior College and the University of Oklahoma, where he received his B.S. degree in 1943, after which he did graduate work at the University of Maryland. In the period 1942 to 1943 he was a laboratory instructor in physics at the University of Oklahoma. He has been research physicist in the Mechanics Div. of the Naval Research Laboratory since 1943, with the exception of a period of active service in the U. S. Naval Reserve in 1944 and 1945. Mr. Smith's work has included ballistics penetration of armor materials; strength of materials, particularly the plastic flow and fracture of metals, plastics, and glass; structural reliability of materials.

He is a member of the American Physical Society, Sigma Pi, and Sigma Xi.

Industrial Water

MAX HECHT AWARD

This award, in honor of the first chairman of Committee D-19 on Industrial Water, is presented to a member of that committee in recognition of outstanding service to the committee in the advancement of its objective—the study of water as an engineering material.

• 1960 award to **Frank N. Speller.**

Frank N. Speller may or may not have celebrated his birthday on January 1, 1960, but the records show that on this New Year's Day he was just starting off on his 86th year.

As usual, he was still full of the curiosity about corrosion which has motivated most of his professional life. He also was turning up regularly at the University Club in Pittsburgh for the lectures with color movies on the far corners of the earth and was always eager to recall adventures of canoe trips and fishing in the Canadian bush.

He was born in Toronto, Canada. Having been graduated from the University of Toronto at the age of 19, he subsequently took his first job in industry with the Carnegie Steel Co. in 1897, but returned almost immediately to the university to serve briefly as an instructor. For three years, around the turn of the century, he was a mining engineer. Then he went back to the steel industry in 1902 as a chemist for the National Tube Co., which he served continuously for 38 years. As metallurgical engineer from 1906 to 1929, he developed an absorbing interest in corrosion which led to the publication of his book, *Corrosion: Causes and Prevention*, in 1926. He was named head of the Metallurgy and Research Department in 1929.

Compulsory retirement at age 65 in 1940 scarcely caused Frank Speller to break stride. During the 20 years since then he has been called in as a consultant on all sorts of corrosion problems. He also found time to prepare the third edition of his book, which appeared in 1951, and to fall off a ladder during a plant inspection. With unquenchable vitality, he survived both ordeals.

A member of ASTM since 1904, Frank Speller has long served Committees A-5 on Corrosion of Iron and Steel and D-19 on Industrial Water. In 1946 he was made an Honorary Member of the Society. He was a Director of the Society from 1927 to 1929.

Other honors have been conferred on him. His alma mater made him a Doctor of Science in 1923. In 1927 the Franklin Inst. awarded him the Longstreth Medal. Four years later he received the medal of the American Iron and Steel Inst. The National Association of Corrosion Engineers in 1947 created the Speller Award, of which he was the first recipient.

Testing of Soils

C. A. HOGENTOGLER AWARD

This award was established by Committee D-18 on Soils to commemorate its first chairman, to be given to authors of outstanding papers on soils presented at a meeting of the Society.

• 1960 award to **Robert L. Schiffman and Charles R. Wilson** for their paper on "The Mechanical Behavior of Chemically Treated Granular Soils."

Professor Schiffman is a native of New York City. He studied at Cornell Univ., where he was granted the degree of Bachelor of Civil Engineering in 1947. After two years as a structural designer, he entered graduate school at Columbia Univ. and received his M.S. in soil mechanics in 1951. From 1950 to 1955, he was a research associate and instructor in soil mechanics at Columbia Univ. He joined the faculty of Lehigh Univ. in 1955, as an assistant professor, and moved to Rennselaer Polytechnic Inst. in 1957. He received his Ph.D. in soil mechanics from Rensselaer in June, 1960.

Professor Schiffman is actively engaged in research for both the Office of Naval Research and for the Army Ordnance, Land Locomotion Laboratory. He has acted as consultant to several firms, including the Bethlehem Steel Co. He is the author or co-author of several papers on the theory of consolidation and secondary compression, stress distributions in soils, and fluid flow through porous media.

During the summer of 1960, Prof. Schiffman will be in residence at Delft Technological Univ., as a guest of the university for the purpose of lecturing and research.

He has been a member of ASTM since 1956, and serves on Committee D-18 and its subcommittees on identification and classification of soils, structural properties of soils, and pile loadings.

Charles R. Wilson studied engineering at Manhattan College and Lehigh Univ., receiving his B.S. C.E. at Manhattan in 1955, and his M.S.C.E. at Lehigh in 1957. He is continuing graduate work at New York Univ. As a Byllesby Fellow at the Fritz Laboratory, Lehigh, he was engaged in research in soil mechanics specifically studying the effect of varying rates of stress and strain on the consolidation of soils. Continuing as a research assistant in soil mechanics, he was engaged in research to determine the effect of stabilizers upon the strength characteristics of soils in collaboration with Prof. Schiffman. Later research in structural concrete was related to determining the factors involved in the ultimate shear strength of steel-reinforced concrete beams. For several months in 1957, and since May of 1958, he has been employed by Goodkind & O'Dea, first as a structural designer for bridges and other structures and later as a computer engineer engaged in the transfer from manual operations to electronic computers.

Mr. Wilson is a member of Epsilon Sigma Pi and Chi Epsilon, associate member of ASCE, and a registered professional engineer in New York State.

Concrete and Its Aggregates

FRANK E. RICHART AWARD

The purpose of this award, commemorating an Honorary Member of the Society is to encourage research and standardization, and to recognize notable contributions in the field of concrete and concrete aggregates.

• 1960 award to **Raymond E. Davis.**

Professor Davis is a graduate of the University of Maine and the University of Illinois with degrees of B.S. in C.E., and M.S. in theoretical and applied mechanics, C.E. and Dr. Eng. Since 1920 he has been associated with the University of California where for many years he was professor of civil engineering and director of the Engineering Materials Laboratory. He retired from active teaching in 1953. During his long career he has served as consultant to various Government agencies and private corporations, including the U. S. Army Corps of Engineers, U. S. Bureau of Reclamation, Civil Engineer Corps of the U. S. Navy, Atomic Energy Commission, Tennessee Valley Authority, and numerous state and local engineering organizations. He also was adviser to the Royal Irrigation Dept., Thailand.

Professor Davis has been a member of ASTM since 1922, and since 1928 has served actively on many committees, most notably Committee C-9 on Concrete and Concrete Aggregates. He is currently a member of the Northern California District Council. In addition to his association with ASTM, he is a Fellow of the American Association for the Advancement of Science and the American Society of Civil Engineers. He is past-president and honorary member of the American Concrete Inst.

Professor Davis is noted for his work in research in the field of cements, aggregates and concretes, and in the design and construction of concrete structures, principally mass concrete such as dams. He is the author or co-author of nearly 100 papers and discussions. The American Concrete Inst. has awarded him its Henry C. Turner Gold Medal, the Construction Practice Award, and twice its Wason Medal. He is a member of Sigma Xi, Tau Beta Pi, Chi Epsilon, and Delta Sigma Chi.

63rd Annual Meeting

Corrosion Research and Tests

SAM TOUR AWARD

The purpose of this award is to encourage research on the improvement and evaluation of corrosion testing methods and to stimulate the preparation of technical papers in this field.

• 1960 award to **Peter J. Sereda** for his paper, "Measurements of Surface Moisture," which was published in the ASTM BULLETIN, Feb., 1958.

P. J. Sereda is a native of West Bend, Sask., Canada. He attended St. Joseph's College and completed his engineering training at the University of Alberta, receiving his degree in chemical engineering in 1943. He was awarded a University of Alberta research scholarship and continued his postgraduate studies while engaged in research for the Chemical Warfare Div. of the Department of National Defense. He received his Master's degree in 1944, and at that time joined the National Research Council. For the next four years he was engaged in research at the Atomic Energy Project of Canada, Chalk River, Ont. Subsequently he has been engaged in research with the Division of Building Research of the National Research Council and is currently associate research officer.

Mr. Sereda has been active on ASTM Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys. He is the author of a number of scientific papers and is a member of the Association of Professional Engineers of Ontario.

Test Methods and Apparatus

RICHARD L. TEMPLIN AWARD

The purpose of this award is to stimulate research in the development of testing methods and apparatus, to encourage the presentation, of the Society of papers describing new and useful testing procedures and apparatus, and to recognize meritorious efforts of this kind.

• 1960 award to **W. H. Goetz and J. W. Shupe** for their paper "A Laboratory Method for Determining the Skidding Resistance of Bituminous Paving Mixtures," presented at the 61st ASTM Annual Meeting in Boston, Mass.

Medals and Awards

Professor Goetz is a native of Ann Arbor, Mich., and a graduate of the University of Michigan where he received his B.S. in chemical engineering in 1936. In 1942 he received his M.S. in chemical engineering from Purdue Univ.

From 1936 to 1938 he was employed by the Michigan State Highway Dept. He then joined the staff of the Joint Highway Research Project at Purdue Univ. with which he is currently associated.

In addition to his membership in ASTM where he has been active on Committees D-1 on Paint, Varnish, Lacquer, and Related Products and D-4 on Road and Paving Materials, Prof. Goetz is also an associate member of the Highway Research Board, serving as a member of the Department of Materials and Construction and as chairman of the Bituminous Division and chairman of the Committee on Bituminous Surface Treatments.

Professor Goetz is the author or co-author of numerous technical papers and is associate editor of the McGraw-Hill *Highway Engineering Handbook*. He is a registered professional engineer in the state of Indiana and is a member of the Indiana and the National Societies of Professional Engineers. He is also a member of Sigma Xi and Phi Lambda Upsilon and is past-president of the Association of Asphalt Paving Technologists.

Concrete and Its Aggregates

SANFORD E. THOMPSON AWARD

This award was established by Committee C-9 on Concrete and Concrete Aggregates to commemorate its first chairman, to be given to authors of papers of outstanding merit in that field, to stimulate research and extension of knowledge, and to recognize meritorious efforts.

• 1960 award to **Stanton Walker and Delmar L. Bloem,** for their paper on "Variations in Portland Cement" presented at the 61st Annual Meeting of the Society in Boston, Mass.

Stanton Walker is a native of Indiana and a graduate of the University of Illinois, from which he received his B.S. degree. In 1917 he joined the staff of the Portland Cement Assn. as a research engineer in the Structural Materials Research Laboratories. Since 1926, he has been director of engineering of the National Sand and Gravel Assn., and since 1930 director of engineering also of the National Ready Mixed Concrete Assn. He is also director of the Joint Research Foundation of NSGA and NRMCA at the University of Maryland. Mr. Walker has been a member of the ASTM since 1920, and has served actively on the Society's committees, including C-7 on Lime, C-9 on Concrete and Concrete Aggregates, C-1 on Cement, C-12 on Mortars for Unit Masonry, and D-4 on Road and Paving Materials. From 1940 to 1942, he served as a member of the executive committee of ASTM and subsequently served as a director from 1951 to 1954.

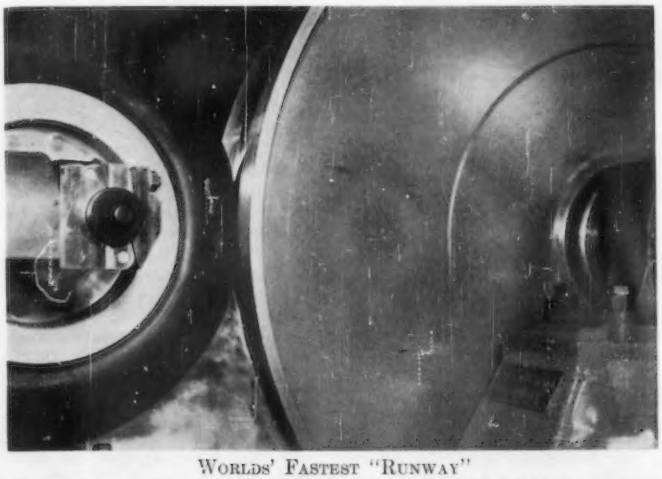
In addition to his activities in ASTM, Mr. Walker is past-president and honorary member of the American Concrete Inst., past-chairman and member of the executive committee of the Highway Research Board, and member of the AIME. He is the recipient of the Roy W. Crum Award of the Highway Research Board, the ASTM Award of Merit and Frank E. Richart Award, and is author of numerous papers dealing with research in concrete and mineral aggregates.

Delmar L. Bloem is a native of South Dakota. He received his B.S. in civil engineering from Iowa State College in 1943. He has been associated with the Iowa Engineering Experiment Station, Chicago Bridge and Iron Co., and in 1945 joined the National Sand and Gravel Assn. and National Ready Mixed Concrete Assn. staff. He was appointed assistant director of engineering in 1949, and was appointed to his present position as associate director of engineering in 1954.

In 1954 Mr. Bloem became a member of ASTM. Since that time he has been extremely active and has served on Committees C-9 on Concrete and Concrete Aggregates, D-4 on Road and Paving Materials, C-12 on Mortars for Unit Masonry Materials, C-11 on Gypsum, as well as on the Washington, D. C., District Council. In addition to his membership in ASTM, Mr. Bloem is a member of the American Concrete Inst., the Highway Research Board, AREA, ASCE, Tau Beta Pi, and Phi Kappa Phi. He is the author or co-author of many tecànical papers and research reports.

Professor Shupe received his B.S. degree from Kansas State Univ. in 1948, his M.S. degree from the University of California at Berkeley in 1951, and his Ph.D. from Purdue Univ. in 1958. He has been associated with the engineering staff of the Convair and Hughes Aircraft companies and has served on the faculty of Purdue Univ., the University of California, and Kansas State Univ., with which he is currently associated.

Professor Shupe is the author of numerous technical publications and a contributor to the *Highway Engineering Handbook*. He is a member of the ASCE, ASEE, NSPE, Sigma Xi, Sigma Tau, and Chi Epsilon.



WORLDS' FASTEST "RUNWAY"

A safe "landing" is completed by this large aircraft tire on a 10-ft-diam flywheel, which simulates landings and take-offs at speeds up to 320 mph. The big wheel is part of a new $2 million test system at the Aviation Products Division of Goodyear Tire & Rubber Co., Akron, Ohio. In the above test, the wheel is rotating at more than 200 mph at the instant the tire slams against it to simulate the landing. The new system generates enough energy to put a golf ball in orbit.

New Tentatives and Standards

63rd Annual Meeting

AT THE 63rd Annual Meeting the Society accepted 129 new tentatives and 3 new standards, the titles and designations of which are given below. Other actions taken at the meeting in regard to standards are summarized in the box.

The numerical designations of the technical committees responsible for these tentatives are shown after the boldface headings.

STEEL (A-1)

Method of Test for:

Notch Toughness of Turbine and Generator Steel Forgings (A 443 – 60 T)

Specifications for:

High-Strength Low-Alloy Structural Manganese Vanadium Steel (A 441 – 60 T)

Carbon Steel Plates with Improved Transition Properties (A 442 – 60 T)

CAST IRON (A-3)

Specifications for:

Austenitic Nodular Iron Castings (A 439 – 60 T)

Ferritic Nodular Iron Castings for Valves, Flanges, Pipe Fittings, and Other Piping Components (A 445 – 60 T)

CORROSION OF IRON AND STEEL (A-5)

Specification for:

Zinc-Coated (Galvanized) Iron or Steel Sheets for Culverts and Underdrains (A 444 – 60 T)

WIRES FOR ELECTRICAL CONDUCTORS (B-1)

Specification for:

Nickel-Coated Soft or Annealed Copper Wire (B 355 – 60 T)

Definitions of Terms Relating to:

Uninsulated Metallic Electrical Conductors (B 354 – 60 T)

NON-FERROUS METALS AND ALLOYS (B-2)

Specifications for:

Remelted Lithium Metal in Ingot Form (B 357 – 60 T)

COPPER AND COPPER ALLOYS, CAST AND WROUGHT (B-5)

Specifications for:

Copper and Copper-Alloy Seamless Condenser and Heat Exchanger Tubes with Integral Fins (B 359 – 60)

Hard-Drawn Copper Capillary Tube for Restrictor Applications (B 360 – 60)

Copper-Nickel Alloys in Ingot, Slab, or Shot Form (B 358 – 60 T)

LIGHT METALS AND ALLOYS, CAST AND WROUGHT (B-7)

Specification for:

Factory Made Wrought Aluminum and Aluminum-Alloy Welding Fittings (B 361 – 60 T)

ELECTRODEPOSITED METALLIC COATINGS (B-8)

Recommended Practice for:

Preparation of Nickel for Electroplating with Nickel (B 343 – 60 T)

CEMENT (C-1)

Methods of Test for:

False Set of Portland Cement (Paste Method) (C 451 – 60 T)

Potential Sulfate Resistance of Portland Cement (C 452 – 60 T)

CHEMICAL-RESISTANT MORTARS (C-3)

Method of Test for:

Flexural Strength of Chemically Setting Silicate-Type Chemical-Resistance Mortars (C 453 – 60 T)

REFRACTORIES (C-8)

Method of Test for:

Hydration Resistance of Basic Brick (C 456 – 60 T)

Disintegration of Carbon Refractories by Alkali (C 454 – 60 T)

Classification of:

Chrome Brick, Chrome-Magnesite Brick, Magnesite-Chrome Brick, and Magnesite Brick (C 455 – 60 T)

CONCRETE AND CONCRETE AGGREGATES (C-9)

Recommended Practice for:

Microscopical Determination of Air-Void Content, Specific Surface, and Spacing Factor of the Air-Void System in Hardened Concrete (C 457 – 60 T)

ASBESTOS-CEMENT PRODUCTS (C-17)

Methods of:

Test for Organic Fiber Content of Asbestos-Cement Products (C 458 – 60 T)

Sampling and Testing Asbestos-Cement Flat Sheets, Roofing and Siding Shingles, and Clapboards (C 459 – 60 T)

Definitions of:

Terms Relating to Asbestos-Cement and Related Products (C 460 – 60 T)

PAINT, VARNISH, LACQUER, AND RELATED PRODUCTS (D-1)

Specifications for:

Isobutyl Alcohol (Iso-Butanol) (D 1719 – 60 T)

Isobutyl Acetate (93 per cent Minimum Ester Grade) (D 1718 – 60 T)

Methods of Test for:

Qualitative Determination of Fish Oil in Drying Oils and Drying Oil Fatty Acids (D 1724 – 60 T)

Water Miscibility of Isopropyl Alcohol (Iso-Propanol) (D 1722 – 60 T)

Water Solubility of Acetone (D 1723 – 60 T)

Permanganate Time of Tricresyl Phosphate (D 1721 – 60 T)

Dilution Ratio in Cellulose Nitrate Solutions for Active Solvents, Hydrocarbon Diluents, and Cellulose Nitrates (D 1720 – 60 T)

Hiding Power of Nonchromatic Paints (D 1738 – 60 T)

Phthalate Ester Color of High Gravity Glycerin (D 1728 – 60 T)

Viscosity of Resin Solutions (D 1725 – 60 T)

Urea Content of Nitrogen Resins (D 1727 – 60 T)

Hydrolyzable Chlorine Content of Liquid Epoxy Resins (D 1726 – 60 T)

Efflorescence of Interior Latex Paints (D 1736 – 60 T)

Elongation of Attached Coatings of Paint, Varnish, Lacquer, and Related Products with Cylindrical Mandrel Apparatus (D 1737 – 60 T)

Preparation of Aluminum Alloy Panels for Testing Paint, Varnish, Lacquer, and Related Products (D 1733 – 60 T)

Making and Preparing Concrete and Masonry Panels for Testing Paint Finishes (D 1734 – 60 T)

Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting (D 1730 – 60 T)

Preparation of Magnesium Alloy Surfaces for Painting (D 1732 – 60 T)

Water Fog Testing of Organic Coatings (D 1735 – 60 T)

Preparation of Hot Dip Aluminum Surfaces for Painting (D 1731 – 60 T)

Recommended Practice for:

Visual Evaluation of Color Differences of Opaque Materials (D 1729 – 60 T)

PETROLEUM PRODUCTS AND LUBRICANTS (D-2)

Method of Test for:

Oil Separation from Lubricating Grease During Storage (D 1742 – 60 T)

Rust Preventive Properties of Lubricating Greases (D 1743 – 60 T)

Functional Life of Ball Bearing Greases (D 1741 – 60 T)

Water and Sediment in Fuel Oils by Centrifuge (D 1796 – 60 T)

Water in Liquid Petroleum Products by Karl Fischer Reagent (D 1744 – 60 T)

Analysis of Commercial Butane-Butene Mixtures (Gas Chromatography Method) (D 1717 – 60 T)

Calculation of Absolute Viscosity (D 1745 – 60 T)

Luminometer Numbers of Aviation Turbine Fuels (D 1740 – 60 T)

Refractive Index of Viscous Materials (D 1747 – 60 T)

Rust Protection by Metal Preservatives in the Humidity Cabinet (D 1748 – 60 T)

ASTM Tables for:

Positive Displacement Meter Prover Tanks (D 1750 – 60 T)

New Tentatives and Standards

ROAD AND PAVING MATERIALS (D-4)

Test for:

Effect of Heat and Air on Asphaltic Materials (Thin-Film Oven Test) (D 1754 – 60 T)

Specifications for:

Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types) (D 1751 – 60 T)

Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Nonbituminous Types) (D 1752 – 60 T)

Hot-Mixed, Hot-Laid Tar Paving Mixtures (D 1753 – 60 T)

COAL AND COKE (D-5)

Test for:

Sulfur in Coal Ash (D 1757 – 60 T)

Carbon Dioxide in Coal (D 1756 – 60 T)

PAPER AND PAPER PRODUCTS (D-6)

Recommended Practice for:

Interlaboratory Evaluation of Test Methods Used with Paper and Paper Products (D 1749 – 60 T)

WOOD (D-7)

Methods of:

Testing Metal Fasteners (D 1761 – 60 T)

Conducting Shear-Block Test for Quality Control of Glue Bonds in Scarf Joints (D 1759 – 60 T)

Evaluating Wood Preservatives by Field Tests with Stakes (D 1758 – 60 T)

Chemical Analysis of Wood Charcoal (D 1762 – 60 T)

Specification for:

Pressure Treatment of Timber Products (D 1760 – 60 T)

RUBBER AND RUBBER-LIKE MATERIALS (D-11)

Specifications for:

Latex Dipped Goods and Coatings for Automotive Applications (D 1764 – 60 T)

Carbon Blacks Used in Rubber Products (D 1765 – 60 T) (jointly with Committee D-24)

Test for:

Solubility of Organic Chemicals (D 1766 – 60 T)

SOAPS AND OTHER DETERGENTS (D-12)

Method of Test for:

Ethylene Diamine Tetraacetate (EDTA) in Soap or Synthetic Detergents (D 1767 – 60 T)

Sodium Alkylbenzene Sulfonate in Synthetic Detergents by Ultraviolet Absorption (D 1768 – 60 T)

TEXTILE MATERIALS (D-13)

Test: for

Linear Density of Cotton Fibers (Array Sample) (D 1769 – 60)

Neps in Wool Top (D 1770 – 60 T)

Sample Reweighing of Lots of Packaged Raw Wool (D 1771 – 60 T)

Conditioning Textiles and Textile Products for Testing (D 1776 – 60 T)

Imperfection Count of Textile Yarns (D 1772 – 60 T)

Elastic Fabrics (D 1775 – 60 T)

Thickness of Textile Materials (D 1777 – 60 T)

Dimensional Change of Knitted Fabrics in Laundering and Dimensional Restorability of the Laundered Fabric (D 1773 – 60 T)

Elastic Properties of Uncrimped Fibers (D 1774 – 60 T)

Colorfastness to Commercial Laundering and to Domestic Washing of Tufted Rugs and Carpets (D 1778 - 60 T)

ADHESIVES (D-14)

Method for:

Climbing Drum Peel Test for Adhesives (D 1781 – 60 T)

Specification for:

Adhesive for Acoustical Materials (D 1779 – 60 T)

Recommended Practice for:

Conducting Creep Tests of Metal-to-Metal Adhesives (D 1780 – 60 T)

INDUSTRIAL WATER (D-19)

Test for:

Operating Performance of Cation-Exchange Materials—Sodium Cycle (D 1782 – 60 T)

Phenolic Compounds in Industrial Water and Industrial Waste Water (D 1783 – 60 T)

PLASTICS (D-20)

Test for:

Brittleness Temperature of Plastic Film by Impact (D 1790 – 60 T)

Evaluation of Welding Performance for Poly(Vinyl Chloride) Structures (D 1789 – 60 T)

Specifications for:

Rigid Acrylonitrile-Butadiene-Styrene (ABS) Plastics (D 1788 – 60 T)

Toluenediisocyanate and Poly(Oxypropylene Glycol) (D 1786 – 60 T)

IPS Rigid Poly(Vinyl Chloride) (PVC) Plastic Pipe (D 1785 – 60 T)

Rigid Poly(Vinyl Chloride) Compounds (D 1784 – 60 T)

LEATHER (Joint ASTM-ALCA Committee)

Method of:

Measuring Thickness of Leather Units (D 1814 – 60 T)

Measuring Thickness of Leather Test Specimens (D 1813 – 60 T)

Test for Water Absorption (Static) of Leather (D 1815 – 60 T)

WAX POLISHES AND RELATED MATERIALS (D-21)

Test for:

Accelerated Aging of Liquid Water-Emulsion Floor Polishes (D 1791 – 60 T)

Water Spotting of Emulsion Floor Polishes (D 1793 – 60 T)

Potential Long-Term Removability Properties of Water-Emulsion Floor Polishes (D 1792 – 60 T)

SUMMARY OF ACTIONS TAKEN AT 1960 ANNUAL MEETING AFFECTING STANDARDS AND TENTATIVES.

	New Standards and Existing Tentatives Adopted as Standards	Standards in Which Revisions Will Be Adopted	New Tentatives	Revisions of Standards and Reversions to Tentatives	Tentative Revisions of Standards	Tentatives Revised	Standards and Tentatives Withdrawn
A. Ferrous Metals—Steel, Cast Iron, Wrought Iron, Alloys, etc.	3	17	6	10	...	37	...
B. Non-Ferrous Metals—Copper, Zinc, Lead, Aluminum, Alloys, etc.	19	35	6	...	...	26	...
C. Cement, Lime, Gypsum, Concrete and Clay Products	27	20	10	...	7	18	...
D. Paints, Petroleum Products, Bituminous Materials, Paper, Textiles Plastics, Rubber, Soap, Water, etc.	92	27	94	7	4	53	12
E. Miscellaneous Subects, Testing, etc.	8	3	12	...	1	7	...
F. Electronic Materials	5	0	1	...	...	...	...
Total	154	102	129	17	12	141	12

ATMOSPHERIC SAMPLING AND ANALYSIS (D-22)

Method for:

Collection and Analysis of Dustfall (D 1739 – 60 T)

CELLULOSE AND CELLULOSE DERIVATIVES (D-23)

Test for:

Intrinsic Viscosity of Cellulose (D 1795 – 60 T)

Cellulose Chain Length Uniformity by Fractional Precipitation of Cellulose Nitrates (D 1716 – 60 T)

Alcohol-Benzene Soluble Matter in Cellulose (D 1794 – 60 T)

CARBON BLACK (D-24)

Specifications for:

Carbon Blacks Used in Rubber Products (D 1765 – 60 T) (jointly with Committee D-11)

Method for:

Sampling Packaged Shipments of Carbon Black (D 1799 – 60 T)

CASEIN AND SIMILAR PROTEIN MATERIALS (D-25)

Test for:

Ash in Casein and Isolated Soy Protein (D 1797 – 60 T)

Fixed Ash in Casein and Isolated Soy Protein (D 1798 – 60 T)

Oil in Casein and Isolated Soy Protein (D 1804 – 60 T)

Free Acidity in Casein and Isolated Soy Protein (D 1801 – 60 T)

Moisture in Casein and Isolated Soy Protein (D 1802 – 60 T)

Nitrogen in Casein and Isolated Soy Protein (D 1803 – 60 T)

Alkali Requirement of Casein and Isolated Soy Protein (D 1800 – 60 T)

ELECTRICAL INSULATING LIQUIDS AND GASES (D-27)

Recommended Practice for:

Estimating Relative Temperature Limits of Dielectric Liquids (D 1805 – 60 T)

Test for:

Refractive Index and Specific Optical Dispersion of Hydrocarbon Liquids (D 1807 – 60 T)

Refractive Index of Askarels (D 1806 – 60 T)

Sampling Askarels (D 1809 – 60 T)

Volume of Oil in Oil-Contaminated Askarels (D 1808 – 60 T)

Specific Gravity of Askarels (D 1810 – 60 T)

Free Chlorides in Askarels (D 1811 – 60 T)

METHODS OF TESTING (E-1)

Specifications for:

Precision Micromesh Sieves (E 161 – 60 T)

EMISSION SPECTROSCOPY (E-2)

Recommended Practices for:

Spectrochemical Computations (E 158 – 60 T)

CHEMICAL ANALYSIS OF METALS (E-3)

Methods for:

Chemical Analysis of Ferroboron (E 31 – 60 T)

Chemical Analysis of Electronic Nickel (E 107 – 60 T)

Test for:

Hydrogen Loss of Copper Powder (E 159 – 60 T)

NONDESTRUCTIVE TESTING (E-7)

Methods for:

Liquid Penetrant Inspection (E 165 – 60 T)

Ultrasonic Contact Inspection of Weldments (E 164 – 60 T)

RADIOISOTOPES AND RADIATION EFFECTS (E-10)

Definitions of Terms:

Relating to Dosimetry (E 170 – 60 T)

APPEARANCE (E-12)

Recommended Practice for:

Goniophotometry of Transmitting Objects and Materials (E 166 – 60 T)

Goniophotometry of Reflecting Objects and Materials (E 167 – 60 T)

ABSORPTION SPECTROSCOPY (E-13)

Recommended Practice for:

General Techniques of Infrared Quantitative Analysis (E 168 – 60 T)

General Techniques of Ultraviolet Quantitative Analysis (E 169 – 60 T)

MATERIALS FOR ELECTRON TUBES AND SEMICONDUCTOR DEVICES (F-1)

Recommended Practice for:

Testing Electron Tube Parts Using a Reference Planar Diode (F 11 – 60 T)

THE ELECTRON MICROSCOPE IN ACTION

Eleventh ASTM Photographic Exhibit. Eugene S. Clarke, United Shoe Machinery Corp.

ASTM Bulletin

No. 247 July 1960

Nineteen-Sixteen
Race Street
Philadelphia 3, Pa.

Research $$$ Available in STP's

While reviewing recently a number of ASTM Special Technical Publications newly off the presses, we were again forcibly struck with the great wealth of information in these books. Each year the Society publishes quite a number of STP's reporting the results of cooperative effort on a wide range of subjects. These are usually symposia, groupings of related papers, or collections of technical data. Frequently they are sponsored by an ASTM technical committee.

One of these new books, in particular, has a number of points about it, which, while perhaps not average for an STP, nevertheless do exemplify what we have in mind. The Symposium on Electron Metallography (STP 262), only 132 pages in length, embodies several outstanding papers covering new techniques and results of research studies in the field.

Much of the pioneering work in the area of electron metallography has been done by Subcommittee XI of Committee E-4 on Metallography, sponsors of the symposium. In the beginning, electron metallography was a new research tool which gave remarkable, high-magnification views of microstructures. It was very difficult, however, to relate the structures observed to those already familiar from the much lower magnifications of the optical microscope. The cooperative efforts and published progress reports of Subcommittee XI have provided the bridge of understanding from the old to the new. This is the kind of vitally needed information that is disseminated through the medium of the STP.

This particular book also embodies some of the finest illustrations in the field that we have seen. For almost three decades, the writer has been impressed with the high quality of the illustrations in ASTM publications. More than once, we have gotten the impression that our photoengravers feel "that ASTM crowd are the fussiest people we deal with." But the fussiness pays off. Engravings are not infrequently redone in order to bring out the detail that is required to illustrate properly a given paper or report.

While printing is a mechanical detail, and it is expected that every publisher will have his printer do the best job possible, ASTM has built a reputation for the fine quality of its publications, which in turn is a reflection of the close cooperation given by our experienced printers.

Every technical paper in the STP's and in our *Proceedings* not only conveys the opinions of the author, but before publication it has also been critically reviewed by other outstanding experts in the field. In addition, there is ample opportunity for presentation of oral and written discussion, much of which helps to shed additional light on the subject at hand.

An important part of any good technical book is the list of references. The papers in our STP's frequently have long lists of carefully edited references, some running to many pages in length.

Covering as they do the entire range of subjects in the field of engineering materials, the STP's are distributed rather widely, but considering the inherent value in these publications we are often led to doubt that all those who can benefit from them are reached. We do notify our members and committee members, usually twice a year, of all new publications. These lists and brief description of the books merit careful scrutiny. A dollar's worth of STP represents an untold value in research.

R.J.P.

MATERIAL QUESTIONS

Nearly every day the mail at ASTM Headquarters includes some questions about materials, specifications, test methods, or related problems. We feel that the answers, many of which are based on information given us by officers of committees in their capacity as committee officers, are of general interest. For the most part inquiries we receive relate to the activities of the Society, either standards, research work, or publications. Often, an inquiry is such that the services of a consultant or independent testing or research laboratory is obviously required; in this event we do not hesitate to so recommend.

Distillation of Petroleum Products

We are revising our country's standard for distillation of petroleum products, and we have a few questions in connection with the ASTM Method D 86 – 59:

1. In Table I on Test Conditions, the temperature of the condenser bath is specified as 0 to 1 C for group 1 products and 0 to 4 C for group 2. How much difference would there be in the results of tests in group 1 at temperatures of 3 to 4 C as compared with 0 to 1 C?

2. The initial boiling point for group 3 is 100 C or below; for group 4 it is above 100 C. However, the same end point (above 250 C) is specified for both groups. Why, then, is the low-range thermometer, 7 C, specified for group 3 and the high-range thermometer, 8 C, for group 4?

3. The temperature of the condenser bath for group 3 is given as 0 to 4 C; for group 4 it is given as 0 to 60. This seems to be a great difference. The end can be high for both these groups.

●1. For products in group 1 (vapor pressure of 9.5 or higher), the condenser bath temperature is held to 0 to 1 C to help prevent excessive distillation losses. Although a large amount of cooperative testing has been done under these conditions, there are no data on the effect of testing group 1 products with the condenser bath temperature between 3 and 4 C. There seems little doubt, however, that this would result in higher losses.

2. You will note that group 3 is provided for products of unusually wide distillation range. If the high-range thermometer were used for this group, some of the thermometer readings during the distillation might well be on the part of the stem that is within the cork support, and could not be seen. As Note 2 of the method indicates, however, the high-range thermometer must be used for group 3 products if the last stages of the distillation extend above 300 C. Also, as indicated in Paragraph 8(*c*), there will be occasions when two distillations will be necessary, one with each thermometer, to cover the entire range. These complications do not arise in testing group 4 products.

3. As indicated in footnote *c* to Table I, the minimum condenser bath temperature which permits satisfactory operation

should always be used. The reason for the 0 to 60 C range in group 4 is to provide for certain gas oils, etc., which yield so much wax in the distillate that the condenser bath temperature has to be raised in order to prevent the solidified wax from obstructing the condenser tube.

Adhesive Test Report

How can the results of a recently completed study of the effect of loading rate on the lap-shear tensile strength of structural adhesives be obtained.

● A paper by H. R. Butzlaff and D. A. George, discussing the interlaboratory test program that will result in revising Method D 1002 to increase the rate of loading from 600 to 700 psi per min to 1200 to 1400 psi per min, will appear in the Symposium on Adhesion and Adhesives, ASTM STP No. 271. It is expected that this STP will be published by August.

Testing Anodic Coatings

Has there been any testing of anodic coatings conducted under the auspices of ASTM?

● Committee B-7 on Light Metals and Alloys exposed a small series of anodically coated aluminum panels for visual observation as part of their 1953 exposure program. These panels were clear mirror finished and are identified by Alcoa coating and finish numbers. They may be seen at ASTM test sites, located at State College, Pa.; Point Reyes, Calif; Freeport, Tex.; Port Authority Building, New York, N. Y.; and Kure Beach, N. C. No published report of the weathering of these panels is contemplated.

Apology

In the May, 1960, issue of the ASTM BULLETIN appeared the paper, "A Technique for Gripping High-Strength Fabrics During Physical Tests." The authors of this paper are Karl F. Plitt, plastics technologist, and Lee A. Dunlap, research assistant, National Bureau of Standards. We regret that, in printing the photographs of the authors and their biographies, we interchanged the photographs so that they appeared with the wrong biographies.

In the biographies of E. H. Waters, J. S. Hosking, and H. V. Hueber, whose paper, "Tests for Potential and Past Moisture Expansion of Ceramic Building Units," appeared in the April issue of the BULLETIN, we neglected to mention that all three authors are officers of the Division of Building Research, Commonwealth Scientific and Industrial Research Organization. Melbourne, Australia.

Schedule of ASTM Meetings

This gives the lastest information available at ASTM Headquarters. Direct mail notices of all district and committee meetings customarily distributed by the officers of the respective groups should be the final source of information on dates and location of meetings. This schedule does not attempt to list all meetings of smaller sections and subgroups.

Date	Group	Place
Sept. 13–15	Committee B-5 on Copper and Copper Alloys	Niagara Falls, Ont. (Sheraton-Brock Hotel)
Sept. 21–22	Committee C-25 on Ceramics for Electronics	Milwaukee, Wis.
Sept. 26–28	Committee C-16 on Thermal Insulating Materials	Lake Placid, N. Y. (Marcy Hotel)
Sept. 27–29	Joint ASTM-TAPPI Committee on Petroleum Wax	Grand Rapids, Mich.
Sept. 29–30	Committee C-21 on Ceramic Whitewares and Related Products	Bedford, Pa.
Oct. 3–6	Committee D-20 on Plastics	Detroit, Mich. (Sheraton-Cadillac Hotel)
Oct. 5–6	Committee C-8 on Refractories	Bedford, Pa. (Bedford Springs Hotel)
Oct. 5–7	Committee D-9 on Electrical Insulating Materials	Detroit, Mich. (Sheraton-Cadillac Hotel)
Oct. 6	Committee C-20 on Acoustical Materials	Philadelphia, Pa. (Society Headquarters)
Oct. 9–13	Committee D-2 on Petroleum Products and Lubricants	Washington, D. C. (Mayflower Hotel)
Oct. 12	Committee C-14 on Glass and Glass Products	Bedford, Pa. (Bedford Springs Hotel)
Oct. 13–14	Committee D-14 on Adhesives	Chicago, Ill.
Oct. 17–18	Committee B-9 on Metal Powders and Metal Powder Products	Philadelphia, Pa. (Society Headquarters)
Oct. 18–21	Committee D-13 on Textile Materials	New York, N. Y. (Sheraton-McAlpin Hotel)
Oct. 20–21	Committee C-3 on Chemical Resistant Mortars	Suffern, N. Y. (Motel on the Mountain)
Oct. 24–25	Committee B-1 on Wires for Electrical Conductors	Washington, D. C. (Mayflower Hotel)
Oct. 27	New England District	Boston, Mass.
Oct. 31–Nov. 2	Rocky Mountain District (joint with American Concrete Inst.)	Tucson, Ariz.

Papers to Appear in Future Issues of the ASTM Bulletin

Development of Test Method for Air-Entrainment of Standard Ottawa Sand—M. R. DeFore and H. J. Corah, National Bureau of Standards.

Flexural and Impact Variations of Phenolic Moldings; A Statistical Round-Robin Study—C. Elmer and E. C. Harrington, Jr., Monsanto Chemical Co.

Development of Improved Insulating Oils—N. W. Furby and F. J. Hanly, California Research Corp.

On the Measurement of Relative Density of Sand—S. Kitago and F. Kozaki, Hokkaido University.

Devices for Simulating Gun Firing under Static Conditions—J. P. Noonan, R. W. Heinemann, S. J. Lowell, and P. B. Tweed, Picatinny Arsenal.

Moisture Penetration of Brick Masonry Panels—T. Ritchie and W. G. Plewes, National Research Council of Canada.

A High Temperature, Vacuum, Axial Fatigue Testing Machine—R. I. Stephens and G. M. Sinclair, University of Illinois.

Determination of the Thermal Stability of Disiloxane Base Hydraulic Fluids—Myra Willard, Hughes Aircraft Co.

NEW ASTM PUBLICATIONS

Prices Set for STP's on Soils, Newer Metals

THE AVAILABILITY of a symposium volume on newer metals (*STP 272*) and a symposium volume on soils (*STP 254*) was announced in the May issue of the ASTM BULLETIN; however the prices of the books had not yet been determined. The prices have now been set. They are:

STP 254, Soils—1959, 384 pages, hard cover, price $9.00, to members $7.20.

STP 272, Newer Metals, 224 pages, hard cover, price $7.25, to members $5.80.

Thermal Insulation Fitting Covers

A SYSTEM of dimensions has been approved to provide a guide for forming thermal insulation fitting covers for pipe. The 162 tables in this publication give a complete tabulation for prefabrication and field fabrication of covers for all standard pipe sizes and shapes.

These standards are sponsored by Committee C-16 on Thermal Insulation Materials as a service to industry. The tables have been in use for a number of years and were actually developed by industry as an acceptable source of dimensional data for pipe covers.

Committee C-16 has given these tables ASTM recognition by adopting them as an adjunct to ASTM Tentative Recommended Practice for Prefabrication and Field Fabrication of Thermal Insulation Fitting Covers (C 450).

Recommended Dimensional Standards for Prefabrication and Field Fabrication of Thermal Insulation Fitting Covers, 166 pages, heavy paper cover, price $5.00, to members $4.00.

Symposium on Air Pollution Control

THE INFLUENCE of wind and weather on potential air pollution of industrial areas is an important consideration in plant location and in measures needed to reduce emission of air pollutants into the atmosphere. This subject as applied particularly to the Pacific Coast area was covered in some detail at the third Pacific Area National Meeting of the Society in October, 1959, at the Symposium on Air Pollution Control. In addition to meteorological factors, the symposium also included papers on analytical methods for aldehydes and fluorides in the atmosphere. The latter discussion was concerned with the rather difficult but very important separation of gaseous and particulate fluorides.

The symposium was sponsored by ASTM Committee D-22 on Methods of Atmospheric Sampling and Analysis. The contents include:

Air Pollution Potential of California Coastal Climate—Elmer Robinson

Wind and Weather Summaries for Chemical Plant Design and Air Pollution Control—R. J. Moore, T. D. Boscia, and R. W. Lundeen

Fluorescent Dyes As Airborne Tracer Materials—H. C. Wohlers, T. E. Kass, and K. R. Johnson

The Colorimetric Determination of Formaldehyde and Methanol from Combustion Sources—Milton Feldstein

Determination of Gaseous and Particulate Inorganic Fluorides in the Atmosphere—M. R. Pack, A. C. Hill, M. D. Thomas, and L. G. Transtrum

STP 281, 44 pages, hard cover, price $1.50, to members $1.20.

Fatigue of Aircraft Structures

EVER AT THE elbow of the aircraft structural designer, hovering like Damocles' sword over every drafting board, is the infernal bogie, fatigue damage. In the fight against this demon, knowledge is power. Much has been discovered about the nature of the insidious fatigue crack; much more remains unknown. What, for example, is the cumulative effect of stress cycles of random amplitudes? In the absence of a rational answer to this question, how do you design tests for a specific piece of hardware, and how do you use the results? What makes a crack propagate? What kinds of cold-working treatments are most effective in parts subjected to fretting? What about low-cycle fatigue? Biaxial stressing?

The list goes on and on. While researchers nibble away at the edges of the unknown, engineers must continue to build serviceable airplanes, using design criteria and test methods based on the latest findings. Publication of such books as the *Symposium on Fatigue of Aircraft Structures* provides the all-important link between research and design application. The papers in this volume range from rather basic discussions of such topics as cumulative damage, crack-propagation rates, and the effect of biaxial stressing, to general philosophies of design and test for handling spectrum-type loading, sonic fatigue, and high-stress, low-cycle fatigue. Surely every design engineer responsible for the integrity of an aircraft structure can benefit from the ideas that are examined in this book. The contents are:

Introduction—H. F. Hardrath

Quantitative and Systematic Attack on Fatigue—E. T. Haire

Development of Fatigue Loading Spectra for Testing Aircraft Components and Structures—A. J. McCulloch

A Method for Sonic Fatigue Testing—R. H. Vreeland

Low-Cycle Fatigue Strength of Pressurized Components—J. Padlog and I. Rattinger

Development Fatigue Testing of a Large Helicopter Rotor Blade—A. A. Lischer

Book Order Form

American Society for Testing Materials
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Gentlemen:

Please send postpaid copies of the following publications for which I enclose $_____

_____ copies **Fatigue of Aircraft Structures, STP 274**
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Production Methods of Cold Working Joints Subjected to Fretting for Improvement of Fatigue Strength—K. T. Waters

A Method for Predicting the Rate of Fatigue-Crack Propagation—A. J. McEvily, Jr., and W. Illg

An Observation Concerning the Cycle Ratio in Cumulative Damage—H. G. Grover

Variable-Amplitude Fatigue Tests of Aluminum-Alloy Specimens—H. F. Hardrath and E. C. Naumann

STP 274, 138 pages, hard cover, price $4.00, to members $3.20.

Humidity, Paper Tests Topic of September 28 Symposium

THE PHYSICAL properties of paper are quite sensitive to changes in relative humidity. Present test methods for paper require that the conditioning and testing room be controlled to 50 ± 2 per cent relative humidity and 23 ± 2 C. Some feel that even these narrow limits are not narrow enough. Because of this, a Symposium on Relative Humidity and Paper Test Methods, jointly sponsored by ASTM Committee D-6 on Paper and Paper Products and the Testing Division of the Technical Association of the Pulp and Paper Industry, will be held on Sept. 28, 1960, in Grand Rapids, Mich. The symposium is in conjunction with the Eleventh Annual TAPPI Testing Conference, Sept. 27–29.

Plans for the symposium are nearly complete. The following papers have been received to date. Some titles are tentative.

Effect of Relative Humidity on Some Physical Properties of Paper—W. E. Bennett and Miss D. M. Crook, British Paper and Board Industry Research Assn.

The Effect of Relative Humidity on the Stress-Strain Properties of Kraft Multiwall Paper—Miss G. A. Bernier and W. E. Carlson, St. Regis Paper Co.

Reasons for 65 per cent Relative Humidity and 20 C, and Other Topics—W. Brecht, Institute für Papierfabrikation, Technische Hochschule Darmstadt.

Effect of Relative Humidity on the Evaluation of Paper Properties—Willmer A. Wink, Institute of Paper Chemistry.

Some Developments in the Measurement of Relative Humidity—A. C. Poulter, Albert E. Reed & Co., Ltd.

Standards in the Measurement of Relative Humidity—Arnold Wexler, National Bureau of Standards.

The Design and Control of Test Rooms and Small Ovens—J. A. Cairns, The Printing, Packaging, and Allied Trades Research Assn.

A Conditioning Room in Which a Great Deal of In-and-Out Traffic Does Not Upset Conditions; a Rapid Conditioner—L. L. Clapp, St. Regis Paper Co.

The Constant-Temperature Room as a Testing Facility—Frank M. Gavan, Armstrong Cork Co.

Ample time will be provided for discussion. Manufacturers of relative humidity measuring and controlling equipment as well as those who have installed such equipment in paper test rooms will have representatives or exhibitors at the symposium. Inquiries should be addressed to T. W. Lashof, National Bureau of Standards, Washington 25, D. C.

Sometimes, Words Fail Us

"Look here, upon this picture . . ."

—Hamlet

YOU CAN describe a hippopotamus to a man, but a photograph does the job more quickly, and nothing impresses like a face-to-face encounter with the beast. Since cameras are expensive, however, and there is not always time for a trip to the zoo, man invented words.

In the 14,000 pages of its massive Book of Standards, the ASTM uses some seven million words to describe the properties and appearance of materials and to specify methods for testing them. But words are not always enough. How would you describe, for example, the magnetic-particle indications produced by a void in a steel casting? Or how would you paint a word picture of the color change on a strip of copper corroded by gasoline?

To cope with such problems, the Book of ASTM Standards frequently refers to adjuncts, or supplementary materials, that take over where language fails. Wherever possible, the job is done by a photograph or series of photographs; but there are times when even that is inadequate—the true picture can be gained only by referring to the flesh-and-blood beast itself.

In most cases, the photographs are reproduced within the covers of the Book of Standards. But they usually must be reduced to fit the page; and in the engraving process, which translates continuous tones of gray into little black dots, some detail is lost. Therefore, full-size glossy prints are made available for those who need the most accurate information. Examples of these are reference photographs for metallic grain size and microstructure; for appearance of cotton yarns; for paint blistering; for air inclusions in mica; for abrasion and erosion of paint coatings; for paint bleeding and chipping; for "neps," or tiny tangles of fibers in cotton; for inclusions in steel; and for magnetic-particle indications of faults in metals. Closely akin to these are the several series of X-ray and gamma-ray negatives for non-ferrous castings and for ferrous castings and welds. All of these are "publications" of ASTM that are really a part of the Book of Standards but do not appear between the covers of the ten Parts.

Examples of comparison standards for which even a photograph is inadequate are specimens of mica for grading visual and electrical quality, and sets of aluminum strips on which have been lithographed colors typical of the corrosion products on copper after exposure to gasoline and other fuels. Standards of this type, of course, can only be referred to in the Book of Standards as available elsewhere.

These two groups of adjunct materials do not by any means exhaust the field. There are, for example, more than one hundred blueprints available which give construction details for many types of apparatus and equipment used in ASTM tests. There are stacks of index, Keysort, and IBM cards containing data for X-ray diffraction and infrared and ultraviolet analyses. There are books of tables for viscosity and density of petroleum products, manuals for rating petroleum fuels, and many miscellaneous charts, graphs, and data sheets that are useful in making ASTM tests.

Part of this conglomeration was recently assembled to make a display at the 63rd Annual Meeting. Anyone viewing that mass of material must surely have agreed with us that the ten-Part Book of Standards is only the beginning.

Forest Products Laboratory Marks Golden Anniversary

IN THREE days of ceremonies, June 2 to 4, 1960, attended by representatives from laboratories, industry, schools, and government agencies, the U.S. Forest Products Laboratory, Madison, Wis., commemorated the 50th anniversary of its founding. A banquet on Thursday evening, June 2, was followed by an assembly and a luncheon on Friday and a guest tour of the laboratory on Friday afternoon. All day Saturday was devoted to a public tour of the laboratory. ASTM was represented at the Friday ceremonies by Vice-President A. Allan Bates, vice-president of research and development, Portland Cement Assn.

At its founding, on June 4, 1910, FPL was dedicated to research aimed at implementing President Theodore Roosevelt's definition of forestry as "the preservation of forests by wise use." Even since then, the laboratory has been seeking ways to make more intelligent use of trees. The record of the laboratory's work stands as a testimonial to the usefulness of scientific research in husbanding our natural

Herbert F. Moore, 1875–1960

With the death of H. F. Moore on April 17, 1960, at the age of 84, the engineering world lost one of its pioneers in the field of materials. As an educator, as a researcher, as a servant to the community, as a true man of culture, Prof. Moore left a lasting mark on his society.

Born in New Hampshire, July 10, 1875, Prof. Moore received his education in mechanical engineering from the New Hampshire College of Agriculture and Mechanics Arts (now University of New Hampshire), Cornell University, and New Hampshire College. The bulk of his professional life was devoted to teaching and research at the University of Illinois, where he was retired as Research Professor of Engineering Materials in 1945.

As a result of his work at Illinois, the name of Herbert F. Moore will always be prominent among the founders of the science of the fatigue of metals. His patient, thoroughgoing attack on the treacherous problem of transverse fissures in railroad rails and his elimination of this costly hazard were classic applications of theory to engineering practice.

During his long career, Prof. Moore published more than 100 articles and papers in the field of engineering materials. More than 25 bulletins and circulars of the Engineering Experiment Station of the University of Illinois bear his name. He also produced two outstanding textbooks: *The Fatigue of Metals* (written jointly with J. B. Kommers), and *Materials of Engineering*.

Through his activity as a member of nine engineering and scientific societies, Prof. Moore worked hard to establish engineering as the respected profession that it is today. The impressive record of this service is contained in the reports that he wrote as a working member of scores of the committees of these organizations. His lively, probing discussions always served to clarify the engineering significance of his own work as well as that of others.

Prof. Moore became a member of ASTM in 1903, just one year after the Society was incorporated. He was ASTM President in 1927–1928. He was elected an Honorary Member in 1938—the highest honor that the Society can bestow. In 1939, he delivered the Edgar Marburg Lecture, "Stress, Strain, and Structural Damage." He was a charter member and first chairman of the now Administrative Committee on Research. His eleven years as a member and nine as chairman still stand as records for length of service. He was one of the organizers of Committee E-9 on Fatigue (organized on recommendation of ACR) and of Committee E-1 on Methods of Testing.

Although Prof. Moore was relatively inactive during the later years of his life, any account of the foundation and development of the technology of engineering materials, and especially the fatigue of metals, would be incomplete without reference to his valuable contributions.

N. L. Mochel States Case for Standardization At AREA Annual Convention

"From cradle to grave, this problem of running order through chaos, direction through space, discipline through freedom, unity through multiplicity, has always been, and must always be the task of education, as it is the moral of religious philosopy, science, art, politics, and economy." These words from *The Education of Henry Adams* were quoted by Norman L. Mochel in a recent address before the American Railway Engineering Assn., in which Mr. Mochel made the point that standardization is not something to enslave us but is rather a tool that can free our hands and minds from the routine for more creative work at the boundaries of knowledge.

The address by Mr. Mochel, past-president of ASTM, and manager, metallurgical engineering, Westinghouse Electric Corp., led off a symposium on standardization which opened the AREA Annual Convention, March 14, 1960.

"There are standards of such fundamental nature that once agreed upon may never be changed," Mr. Mochel said. "... standard gage track spacing is an example. But I look upon most standards as representing a new tried and firm level or platform, to which we have attained, where we may rest briefly or longer, only to move on to newer activities and needs beyond. Standards give us the security of position that allows us to spend our time, our manpower, our money, our energies on other problems, and to move forward. And of course each move to standardization must be surrounded with such care that there are open roads ahead. We must not paint ourselves into a corner."

Mr. Mochel noted that the railroad industry has accomplished much in the area of standardization and has been greatly benefited thereby, but he observed that much remains to be done. "There is no question as to financial returns from well-directed standardization," he said. "To most of us in industry this is important. There is no question but that standardization of proper sorts leads to greater efficiency in many ways... Clear standards provide a common language; they make for reliability and reproducibility; they make possible stores stocks no matter where the storage takes place; they make possible better inventory control; they reduce investments in tools and equipment."

Suggesting that a good body of standards represents a treasury of engineering knowledge from which technology may draw at will, Mr. Mochel cited ASTM standards as an example: "One hears much of manpower problems in these days and those ahead. The shortage of engineers and the most effective use of engineers is a much discussed subject. Standardization is of tremendous value in this problem. May I use one example, with which you and I are familiar. It required 15,000 pages to publish the 2645 standard specifications and methods of test, issued in 1958, and the ten supplements in 1959, of the ASTM. These are under the care of 85 main committees, with approximately 9500 perosns who are members of ASTM, or who represent members, plus some 600 more who do not have any membership connections. And then the work represents the contributions of many thousands who went before, and the work of research institutions and commercial laboratories. One can get much engineering when he uses standards. The creation and use of good standards will free engineering personnel to move on to other and more difficult problems."

Refuting the argument of some that standards threaten to hinder or stifle progress, Mr. Mochel argued that "engineers will not stop long with ... a standard that bears improvement. There is always room for better standards, and ... there is probably more chance of improvement from the level of a good standard than from the shifting sands of whim and fancy."

The symposium on standardization was developed by the 1959–1960 AREA President F. R. Woolford, chief engineer, Western Pacific Railroad, and Neal D. Howard, executive secretary of AREA. Mr. Howard has followed the work of ASTM for a good many years, going back to his pre-AREA days when he was an editor of railway engineering publications. At that time, he could be seen regularly at ASTM Annual Meetings gleaning news on standards of interest to the railroads.

District Activities

New District Officers Elected

IN THE even-numbered years each of the 17 ASTM districts elects district council officers as well as a portion of its council members. Below are listed the newly elected officers of each district. Some have served in district capacities in the past; others are new; but all will strive to provide district programs to meet the needs of their areas. Members and technical committee members interested in participating in district affairs are urged to get in touch with their district officers.

Central New York

Chairman: G. H. Harnden, General Electric Co.
Vice-Chairman: J. H. Brown, State University College of Forestry.
Vice-Chairman: J. S. Meyer, International Business Machines Corp.
Secretary: A. P. Tracy, John A. Manning Paper Co.

Chicago

Chairman: C. S. Macnair, Acme Steel Co.
Vice Chairman: K. R. Parker, Joslyn Manufacturing and Supply Co.
Secretary: R. Callis, Inland Steel Co.

Cleveland

Chairman: A. G. Gray, *Metal Progress*
Vice-Chairman: George Krumlauf, Republic Steel Corp.
Secretary: A. H. DuRose, The Harshaw Chemical Co., Inc.

Detroit

Chairman: C. F. Nixon, General Motors Corp.
Vice-Chairman: C. E. Topping, Consumers Power Co.
Secretary: B. E. Tiffany, Ford Motor Co.

New England

Chairman: F. J. Mardulier, Dewey and Almy Chemical Div., W. R. Grace & Co.
Vice-Chairman: Carl G. Johnson, The Presmet Corp.
Secretary: William L. Glowacki, Eastern Gas and Fuel Associates.

New York

Chairman: Lincoln T. Work, Consultant.
Vice-Chairman: E. R. Thomas, Consolidated Edison Co. of N. Y., Inc.
Vice-Chairman: E. J. Dunn, Jr., National Lead Co.
Secretary: J. S. Pettibone, The International Nickel Co., Inc.

Northern California

Chairman: G. J. Grieve, DeSoto Chemical and Coatings, Inc.
Vice-Chairman: R. C. Vollmar, Standard Oil Company of Calif.
Secretary: C. H. Fitzwilson, Columbia-Geneva Steel Div., U. S. Steel Corp.

Ohio Valley

Chairman: A. H. Thomas, Armco Steel Corp.
Vice-Chairman: W. J. Klayer, Aluminum Industries, Inc.
Secretary: D. E. Krause, Gray Iron Research Inst., Inc.

Philadelphia

Chairman: H. W. Stuart, U. S. Pipe and Foundry Co.
Vice-Chairman: W. F. Bartoe, Rohm & Haas Co.
Vice-Chairman: Percival Theel, Philadelphia Textile Inst.
Secretary: F. H. Pennell, De Laval Steam Turbine Co.

Pittsburgh

Chairman: E. J. Holcomb, Aluminum Company of America.
Vice-Chairman: A. S. Orr, Gulf Oil Corp.
Secretary: W. E. Walters, Pittsburgh Testing Laboratory.

Rocky Mountain

Chairman: P. J. Elsey, Engineering Experiment Station, University of Utah.
Vice-Chairman: E. C. Higginson, Bureau of Reclamation.
Secretary: W. A. Gordon, Utah State University (Library).

St. Louis

Chairman: A. M. Siegel, Industrial Research and Testing Laboratories.
Vice-Chairman: A. C. Weber, Laclede Steel Co.
Secretary: Jack Rausch, Russell, Mullgardt, Schwarz, Van Hoefen, Architects

Southeast

Chairman: R. W. Mooty, Tennessee Coal and Iron Div., U. S. Steel Corp.
Vice-Chairman: Lane Mitchell, Georgia Institute of Technology.
Secretary: R. E. Deas, American Cast Iron Pipe Co.
Asst. Secretary: F. E. Richart, Jr., University of Florida.

Southern California

Chairman: R. E. Paine, Aluminum Company of America.
Vice-Chairman: J. B. Howe, Maurseth & Howe.
Vice-Chairman: D. E. Bowers, General Petroleum Corporation of Calif.
Secretary: Jonmore Dickason, Metal Control Laboratories, Inc.

Southwest

Chairman: B. B. Manuel, W. H. Curtin & Co.
Vice-Chairman: H. D. Wilde, Humble Oil and Refining Co.
Vice-Chairman: Cedric Willson, Texas Industries, Inc.
Vice-Chairman: M. W. Fry, Dierks Forests, Inc.
Vice-Chairman: B. J. Heinrich, Phillips Petroleum Co.
Secretary: R. C. Anderson, Consulting Engineer.

Washington, D. C.

Chairman: Harold Allen, Department of Commerce.
Vice-Chairman: R. C. Berry, Commonwealth of Virginia, Department of Agriculture.
Vice-Chairman: C. E. Proudley, Carolinas Ready Mixed Concrete Assn.
Vice-Chairman: Francis Scofield, National Paint, Varnish, and Lacquer Assn., Inc.
Vice-Chairman: J. E. Wood, Maryland State Roads Commission.
Secretary: J. R. Dise, Cement and Concrete Reference Laboratory, National Bureau of Standards.

Western New York–Ontario

Chairman: R. L. Terrill, Spencer Kellogg & Sons, Inc.
Vice-Chairman: E. G. Baker, The Steel Company of Canada, Ltd.
Vice Chairman: D. A. Hall, Eastman Kodak Co.
Secretary: M. E. Ehrlich, American Lubricants, Inc.

DETROIT

Corrosion Uncertainties Explained

"WHAT WE KNOW and Don't Know About Corrosion" was explored by Frank L. LaQue, ASTM President, and Vice-President and Manager of Development and Research Division, The International Nickel Co., Inc., speaking at a joint meeting of the ASTM Detroit District, The Electrochemical Society, and the National Association of Corrosion Engineers in Detroit.

Based on his extensive work in the field, Mr. LaQue presented current thinking about the mechanisms of corrosion, its prevention, and the interpretation of corrosion test data. He stressed, however, that there were many uncertainties in the study of corrosion. This is particularly true when one must predict the reactions of metals in new and unusual environments. "Explanations of reactions after the fact are considerably easier to come by than explanations before the fact," he stated.

In making his appearance before the Detroit District meeting, Mr. LaQue concluded a tour of ASTM districts which took him to 11 of the Society's 17 districts from coast to coast. He began his tour of the districts last October at the Third Pacific Area National Meeting.

NEW ENGLAND

Materials in the Jet-Atomic Age

AT A FULL day meeting on May 6 of the New England District with Worcester Polytechnic Inst. at Worcester, Mass., the role of materials in the jet-atomic age was explored.

Lt. Commander Frederick A. Anderson, associate professor of mechanical engineering at Worcester Polytechnic, stressed the importance to students of participation in laboratory work. Such experimental work, he said transcends the contents of the specific experiment if fundamentals are stressed. He stated further that clinging to old experiments because of antiquated hardware or presentation of exotic technologies should both be avoided in favor of demonstrating underlying principles.

Given A. Brewer, chief engineer, Brewer Engineering Laboratories, described methods of measuring strains in the principal components of submarine nuclear reactors. It was clear from Mr. Brewer's account that the use of strain gages in this area is not routine, that much ingenuity and skill has been brought to bear. The correlation between the accuracy of a result and the impressiveness of the hardware, said Mr. Brewer, may be high, but it is not infallible.

The technical session was closed with a three-part presentation by representatives of the Norton Co., who were introduced by Fred Watts, factory manager.

R. J. Westerholm, product engineer, described the Rokide process for depositing a layer of refractory material on virtually any substrate. Thin rods of the desired refractory are fed into what is essentially a spray gun. Here, the rod is heated fiercely until it melts and drips; the liquid drops are impelled toward the desired surface by the velocity of combustion gases.

L. H. Trostel, research engineer, described the manufacture of nose cones for hypersonic missiles. As a first step, the Rokide process is used to build up a fairly thick layer of refractory upon a mandrel of suitable shape. The resulting hollow paraboloid of revolution is then baked to consolidate the structure and to develop desirable physical properties. The raw nose cone is then subjected to extensive grinding, both inside and outside, to very precise tolerances. Mr. Trostel exhibited a finished nose cone of alundum during his talk.

T. M. McNally, product engineer, described recent developments in pebble heaters. It is becoming increasingly desirable to carry out wind-tunnel experiments with gases heated to temperatures as high as 4000 F. Pebble heaters are not new, but recent developments have led to great extensions of temperature range and utility. In the zones of most extreme temperatures, zirconia balls are used as the heat-transfer device. Some of the larger heaters cost millions of dollars and exemplify the magnitude of the effort being expanded on research in the jet age.

Earlier in the day a tour of the campus was held including the school's "swimming pool" type nuclear reactor.

A luncheon address by Worcester President A. B. Bronwell treated briefly the history of the institute, its current status, and its plans and aspirations. Dr. Bronwell was followed by ASTM Vice-President Miles N. Clair, who told the group of several new and interesting developments in ASTM.

The highlight of the evening dinner session was a presentation by Mrs. Robert H. Goddard of Worcester, widow of the famous rocket pioneer. Her subject, "Road to the Stars," was a description on a popular level of the pertinent science and technology underlying modern attempts to reach out into space. She presented a film made for the Rocketdyne Corp. which included brief glimpses of her late husband and some of his experimental work. Mrs. Goddard's talk was especially suitable, since, as she noted, she was directing parts of it particularly to the ladies.

Arrangements for the meeting were made by Ross Alger, director of development, Worcester Polytechnic Inst.; Carl G. Johnson, New England District, of the Presmet Corp., Worcester, Mass., and Prof. Donald N. Zwiep, Worcester Polytechnic Inst.

CENTRAL NEW YORK

Nondestructive Testing

THE CENTRAL NEW YORK District followed its usual custom of starting its meeting during the daytime when it held a meeting in Syracuse, N. Y., on April 27. The meeting, sponsored jointly by ASTM Central New York District and Forest Products Research Society, started with a tour of the laboratories of the College of Forestry at the University of Syracuse. Those who participated were quite interested in the very excellent and complete manner in which the laboratories are equipped so that many basic studies on the properties of wood and of paper can be carried on.

Following a social hour and excellent dinner at the Drumlins Country Club, which were well attended, the meeting was addressed by Prof. A.G.H. Dietz of the Massachusetts Institute of Technology on "Nondestructive Testing of Materials." This address very appropriately discussed the various nondestructive tests that have been applied to the testing of adhesive joints, which is one of the important considerations being studied at the College of Forestry Laboratories. Professor Dietz demonstrated how sonic methods of testing can be used very effectively.

E. A. Anderson, past chairman of the Northeast Section of the Forest Products Research Society, spoke most interestingly concerning the activities of that organization and how they tied in with those of ASTM.

ASTM Associate Executive Secretary R. E. Hess described briefly some of the current activities of ASTM with particular reference to the newer committees that have recently organized or which are in process of organization.

Arrangements for the meeting were made by W. A. Mader, Oberdoerfer Foundries, Inc.; R. N. Stenerson, Carrier Corp.; Prof. J. H. Brown, State University College of Forestry; and Dr. Anderson.

NEXT: A DIAMOND AS BIG AS THE RITZ

The Single Crystal Division of Semi-Elements, Inc., Saxonburg, Pa., claims to have produced the largest plastic scintillation fluor ever made (above). These single crystals, before machining, weigh about 400 lb, are normally sold in the rough. Larger sizes can be produced, but so far there has been no demand. The company is looking for an order for a scintillation fluor large enough to encapsulate a human body entirely and thus provide a more precise measure of radiation exposure.

Technical Committee Notes

New Area of Standardization: Ceramics for Electronics

On April 28, 1960, Committee C-25 on Ceramics for Electronics held its organization meeting in Philadelphia, Pa. The field that Committee C-25 covers was unknown a little over 25 years ago. At that time an extensive amount of research work was initiated on titania. It was soon discovered that the titanates, zirconates, and stannates of various divalent metals, such as barium, strontium, calcium, etc., and their mixtures (having the perovskite structure), showed extremely high dielectric constants. Later it was discovered that barium titanate ceramic materials exhibit piezoelectric response and other potentially useful properties.

Research on metallic oxides as magnetic materials (the basic mineral is magnetite) also began about 20 years ago, and because of their high resistivity as compared to the magnetic alloy metals, the oxides found immediate application wherever high frequencies are involved. The garnet crystal structure is a more recent area of study. The garnets have shown properties superior in several respects to the spinel structure of the metallic oxide magnetic materials. Another promising group is the series of hexagonal compounds that show preferential magnetization along one of the crystal axes. By varying the elements in these structures and varying the treatments during manufacture, a broad array of properties can be designed into the finished materials. The work carried out so far in this field should be regarded as only the opening phase of development of a new field of ceramic technology, the full realization of which is still many years in the future.

ASTM Committee C-21 on Ceramic Whitewares and Related Materials entered this field in 1951. In that year a task group was formed to cover ferroelectric ceramics; in 1956 another group was formed to cover the ferrimagnetic ceramics. The former group initiated significant interlaboratory experiments on barium titanate both as raw powdered material for fabrication experiments and as fabricated disks for heat treatment experiments.

During this time the White Wares Division of the American Ceramic Society became the forum for technical papers in this field, following many symposia sponsored by Rutgers University Ceramic Department. By 1958 the large number of papers presented at Ceramic Society sessions and the increasing number of members interested in these ceramic materials indicated that a new division would be necessary. Shortly after the ACS Electronics Division was established its members requested that ASTM establish a parallel standards-producing committee.

After a thorough study, the ASTM Board of Directors approved the formation of the new committee on January 19, 1960. The scope adopted by Committee C-25 at its organization meeting is as follows:

> Definitions of terms and formulation of test methods and specifications covering ceramic materials for electronic applications and promotion of research in this field.
>
> The principal materials included in this scope are: low loss dielectric ceramics, ferroelectric and nonmetallic magnetic materials, and ceramic type semiconductors and composites. The scope does not include materials for electron tubes, electric discharge and semiconductor devices, and electrical tests for electrical porcelain.

The officers elected were:

Chairman: R. L. Cook, University of Illinois.
Vice-Chairman: H. H. Frahme, Alite Division, U. S. Stoneware Co.
Secretary: W. W. Coffeen, Metal and Thermit Corp.

Nine subcommittees were formed, with the following titles: Executive, Classification and Nomenclature, General Methods of Test, Electrical Insulating Materials, Ferroelectrics, Nonmetallic Magnetic Materials, Semiconductor Materials, Composites, Research.

Subcommittee IV on Electrical Insulating Materials, to begin with, will collect all available test methods for review. The materials for which the tests will be designed are considerably different from the classical ceramic insulators—electrical porcelain, steatites, and aluminas. For high-frequency application, new steatites incorporate heavier cations, finer raw materials, and improved processing; alumina ceramics have over 99 per cent alumina. Ceramic insulating materials having unusual properties contain as their principal crystalline phases mullite, zircon, forsterite, cordierite, wollastonite, or β-spodumene. Ultra low-loss ceramic dielectrics are prepared using wollastonite with heavy cations such as lead, barium, and bismuth.

Subcommittee V on Ferroelectrics covers those titanates, zirconates, and stannates of the various divalent metals that show extremely high dielectric constants (ranging from several hundred to several thousand), having the perovskite ($CaTiO_3$) structure. Certain columbates and tantalates that do not have the perovskite structure also are included.

This group is assembling test methods used in the industry for consideration as possible standards.

Of the many interesting properties that can be built into these materials, one is the piezoelectric effect of electrically poled barium titanate. The discovery of this property was a revolutionary contribution to the electromechanical transducer art.

Subcommittee VI on Nonmetallic Magnetic Materials covers magnetic iron oxide compounds, or "ferrites," having, in general, the spinel structure. Their high electrical resistivity as compared to metallic magnets indicates their use for applications wherever high frequencies are involved. Several distinct classes of these materials have evolved with respect to chemical constitution as well as application: the nickel-zinc and manganese-zinc "ferrites" for transformer cores, cup cores, and radio antennas; barium "ferrites" for permanent magnets; magnesium-manganese "ferrites" for signal storage; and high insulating "ferrites" for microwave equipment.

The work of this subcommittee, which was recently transferred from Committee C-21, is divided into three

working groups: Task Group A on Microwave Ferrites has three methods in preparation (methods of test for ferrimagnetic resonance linewidth and gyromagnetic ratio of nonmetallic magnetic materials, for complex dielectric constant of nonmetallic magnetic materials, and for magnetization of a magnetic material); Task Group B on Ferrite Computer Application has one method in preparation (method of test for nonmetallic magnetic cores to be used in a coincident current memory with a 2:1 selection ratio); and Task Group C on Pulse Transformer Ferrites is the third working group.

Subcommittee VII on Semiconductor Materials covers sintered mixtures of metallic oxides of cobalt, manganese, nickel, iron, and copper, as well as sulfides, tellurides, and borides.

Thermistor materials with large positive temperature coefficients (resistivity increasing with increasing temperature) consist of barium titanate or barium strontium titanate to which small amounts of lanthanum, bismuth, thorium, or rare earths have been added. Certain alkali alumino-silicates are used for very high temperature applications.

Of the many intermetallic semiconducting compounds, only bismuth telluride, indium antimonide, and lead telluride are being produced for commercial consumption.

Subcommittee VIII on Composites will cover those combinations of the materials covered by the other subcommittees, or with other ceramics or metals. This subcommittee will be specifically concerned with special films and coatings on various substrates, laminates, special impregnates, or bonded particulates. It will also work closely with the other committees on ceramic-metal seals and on glass-metal seals as well as on printed circuits.

Glass Durabilty Test Reviewed

Progress on the glass durability test using powdered glass immersed in water and tested under the pressure of an autoclave was reviewed at a meeting of Committee C-14 on Glass, April 27, in Philadelphia, Pa. It is expected that this study will provide data for a classification of glasses based on chemical durability.

Current work includes revision of Methods C 169, C 240, and C 336. Interlaboratory tests have been completed for revision of the Methods for Chemical Analysis of Glass Sand (C 146).

Revisions of Methods C 147, C 148, C 225, and C 429 have been accepted by the Administrative Committee on Standards.

New SBR Rubbers Announced by Committee D-11

NEW NUMBERS have been assigned by ASTM Committee D-11 on Rubber and Rubber-Like Materials to 16 new styrene-butadiene rubbers (SBR) which have been brought on the market during the past several months. The assignment of these numbers was made by Subcommittee XIII on Synthetic Elastomers, B. S. Garvey, chairman, in accordance with the Tentative Recommended Practice for Description of Styrene-Butadiene Rubbers (SBR) and Butadiene Rubbers (BR) (D 1419 – 60 T).

The new SBR numbers and the corresponding product descriptions are shown in the table (below and next page).

Structural Sandwich Constructions

The use of sandwich construction in jet-powered aircraft and missiles has resulted in the need for a new set of standards for evaluating the properties which become critical under the extreme conditions encountered. The need for measuring internal friction and fatigue strength of core materials, sonic fatigue properties of constructions, and the use of microlightweight sandwich construction for solar work are in this category. These matters were discussed at the meeting of Committee C-19 on Structural Sandwich Constructions held at the U. S. Forest Products Laboratory, Madison, Wis., on April 26 and 27. Apparatus for measuring internal friction and fatigue strength of core materials used in sandwich construction was reviewed.

Testing procedures for measuring peel strength, which has been a very difficult field to develop, were again reviewed, including the Martin and Hexcel methods. A flexure creep test method is in process of letter-ballot acceptance. A recommended practice for testing at high or low temperatures will again become a project for development of a standard.

DESCRIPTION OF TYPES OF NEW STYRENE-BUTADIENE RUBBERS (SBR)—ASSIGNMENT OF NEW CODE NUMBERS (ASTM D 1419)

Numbers assigned	1510	1604	1606	1607[a]	1608	1800	1802	1806
Date assigned	2/15/60	10/25/59	1/19/60	2/23/60	5/31/60	10/25/59	10/25/59	1/19/60
Requested by	Goodyear	Shell	Shell	Shell	Copolymer	Shell	Shell	Shell
Distinctive feature	low Mooney	ISAF black low oil	HAF black process oil	reclassification of SBR1804	ISAF black, dispersant-free low oil	ISAF black high oil	HAF black high oil	FEF black high oil
Close previous number, if any	1508	..	Shell OB-113-C	..	Carbomix 3752	..	..	Shell OB-106-X
Type	1500	1600	1600	1600	1600	1800	1800	1800
Nominal temperature, deg Fahr	43	43	43	43	43	43	43	43
Activator	FRA	FRA	FRA	FRA	FRA	FRA	FRA	FRA
Shortstop	ND	ND	ND	ND	ND	ND	ND	ND
Antioxidant	NST	ST	ST	ST	ST	ST	ST	NST
Catalyst	OHP	OHP	OHP	OHP	OHP	OHP	OHP	OHP
Emulsifier	FA	RA	RA	RA	RA	mixed	mixed	RA
Nominal bound styrene, per cent	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5
Nominal conversion, per cent	60	60	60	60	60	60	60	60
Nominal Mooney viscosity ML 1 + 4 (212 F), polymer	32	65	..	..	..	..	49	..
Nominal Mooney viscosity ML 1 + 4 (212 F), compound	..	..	56	62	58	55	..	50
Coagulation	SA	SA	Acid	SA	acid	SA	SA	SA
Carbon black:								
Type	..	ISAF	HAF	HAF	ISAF	ISAF	HAF	FEF
PHR[b]	..	60	50	60	52	82.5	82.5	60
Oil:								
Type	..	HI-AR	HI-AR	HI-AR	HI-AR	HI-AR	HI-AR	NAPH
PHR[b]	..	10	10	10	12.5	51.2	56.8	37.5
Finishing	normal	normal	normal	normal	normal	normal	normal	normal

[a] SBR 1607 was originally incorrectly listed and published as SBR 1804. [b] Parts per hundred of rubber.

NOTE.—Abbreviations and symbols are defined as follows: AR = Aromatic. FA = Fatty acid. FEF = Fast extrusion furnace. FRA = Free radical type, that is, iron pyrophosphate, peroxamine sulfoxylate. HAF = High abrasion furnace. HI-AR = Highly aromatic. ISAF = Intermediate super abrasion furnace. NAPH = Naphthenic. ND = Nondiscoloring. NST = Nonstaining. OHP = Organic hydroperoxide RA = Rosin acid. SA = Salt acid. SRF = semireinforcing furnace. ST = Staining.

There is increased emphasis on the development of standards needed in the building construction field. Topics discussed at the meeting included nondestructive testing, accelerated aging tests on building panels, and test methods for determining shear properties, modulus of elasticity in bending, and modulus of rigidity in bending of corrugated-faced building panels with foamed cores.

In addition to the regular meetings of the subcommittees and the main committee, a conducted tour of the Forest Products Laboratory was made. At a dinner meeting, L. J. Markwardt, retired assistant director of the Forest Products Laboratory and former president of ASTM, presented a talk on the International Exposition in Brussels accompanied with color slides.

The Committee elected the following officers for the coming two-year term: S. Yurenka, Narmco Industries, chairman; E. W. Kuenzi, U. S. Forest Products Laboratory, vice-chairman; J. P. Reese, The Martin Co., secretary; and Walter Lovett, Pittsburgh Corning Corp., membership secretary.

C-21 Recognizes 45-Year Member

Committee C-21 on Ceramic Whitewares and Related Materials, at its meeting on April 25, in Philadelphia, Pa., presented Arthur S. Watts with an ASTM pin inscribed with his name and the date he joined the Society (1915), for long and faithful service to the committee. Mr. Watts has held the chairmanship of Subcommittee I on Nomenclature since the committee was established.

Data from an interlaboratory study to determine the best angle for specular gloss measurements of gloss-, semimat-, and mat-finish glazed tile indicate that the most significant values were obtained with the 20-deg glossmeter for the gloss-finish tile and with the 60-deg glossmeter for the mat-finish tile. Further work will be reported at the next meeting.

New methods in preparation include a procedure for determining the resistance to crazing of fired glazed ceramic whitewares in which moisture expansion is not induced, as is the case in the autoclave test, Method C 424. A method to determine the resistance of overglaze decorations to attack by soaps and detergents in domestic use and a method for determining the electrical resistance of conductive ceramic tile are being completed.

Progress was reported on methods to determine particle size of plastic and nonplastic clays, and various physical tests for foam ceramics, ceramic tile, and chinaware.

Considerable interest in tension testing of ceramics as a substitute for the modulus of rupture test was the subject of a special meeting. It was decided to collect all ideas and experience on tension testing in the form of a symposium to be presented at a future meeting.

The committee recognizes that more ceramic materials are being designed into nuclear reactors, but lack of service data prevents too wide a diversity of use at present. At present, only two areas are subject to standardization—nuclear graphite and ceramic fuel elements. Such standardization, however, is too early to be based on reactor experience—10 to 15 years of service will be necessary before such standards would have a firm factual basis. As a start, however, the committee is collecting information on nuclear graphite as to the properties the consumers want and to what extent the producers can vary graphite properties. Methods of determining trace elements are also being pursued. The current orders of nuclear grade graphite fall into a few well defined types, and as a first approximation these are being considered as possible standards.

Since 1951 the committee has been working to develop standards for various ceramic specialties in the electronics field. The group on nonmetallic magnetic materials is developing several methods. Interest in this area developed to a point that a new committee was inevitable. Committee C-25 on Ceramics for Electronics was organized on April 28, and the work of Committee C-21 in that area has been transferred to the new committee.

Technical Committee Notes

Vacuum Microbalance Weighs Atoms

One atom of oxygen weighs about 2.65×10^{-23} g as calculated from known physical constants. While a balance has not yet been devised that is capable of weighing single atoms directly, there is one that can weigh as little as 10^{14} atoms of oxygen, or 2.65×10^{-9} g. Such a balance was described by S. P. Wolsky, addressing a luncheon meeting of Committee F-1 on Materials for Electron Tubes and Semiconductor Devices at its meeting on June 16 in Boston. Dr. Wolsky is studying "atomically clean" surfaces, that is, surfaces upon which there are no foreign

DESCRIPTION OF TYPES OF NEW STYRENE-BUTADIENE RUBBERS (SBR)—ASSIGNMENT OF NEW CODE NUMBERS (ASTM D 1419) *(Continued)*

Numbers assigned	1807	1808	1809	1810	1811	1813	1814	1815
Date assigned	1/19/60	2/12/60	4/10/60	4/10/60	5/31/60	5/31/60	5/31/60	5/31/60
Requested by	Shell	Shell	Goodrich-Gulf	Goodrich-Gulf	Copolymer	Copolymer	Copolymer	Copolymer
Distinctive feature	ISAF black high oil	HAF black high oil	HAF black 37.5 PHR oil	FEF black 50 PHR oil	SRF black dispersant-free low oil	ISAF black dispersant-free medium oil	ISAF black dispersant-free high oil	HAF black dispersant-free high oil
Close previous number, if any	Shell OB-111-X	Shell ОБ-114-С	Ameripol 4750	Ameripol 4751	Carbomix 3756	Carbomix 3753	Carbomix 3758	Carbomix 3760
Type	1800	1800	1800	1800	1800	1800	1800	1800
Nominal temperature, deg Fahr	43	43	43	43	43	43	43	43
Activator	FRA	FRA	FRA	FRA	FRA	FRA	FRA	FRA
Shortstop	ND	ND	ND	ND	ND	ND	ND	ND
Antioxidant	ST	ST	ST	NST	ST	ST	ST	NST
Catalyst	OHP	OHP	OHP	OHP	OHP	OHP	OHP	OHP
Emulsifier	RA	mixed	mixed	FA	RA	mixed	mixed	mixed
Nominal bound styrene, per cent	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5
Nominal conversion, per cent	60	60	60	60	60	60	60	60
Nominal Mooney viscosity ML 1 + 4 (212 F), polymer	..	..	..	..	..	..	..	..
Nominal Mooney viscosity ML 1 + 4 (212 F), compound	68	48	53	50	46	62	60	45
Coagulation	SA	acid	acid	acid	acid	acid	acid	acid
Carbon black:								
Type	ISAF	HAF	HAF	FEF	SRF	ISAF	ISAF	HAF
PHR[b]	75	75	75	100	75	60	75	75
Oil:								
Type	AR	HI-AR	HI-AR	NAPH	HI-AR	HI-AR	HI-AR	NAPH
PHR[b]	37.5	50	37.5	50	17.5	37.5	50	50
Finishing	normal	normal	normal	normal	normal	normal	normal	normal

atoms. Actually, such surfaces are never attained in practice but are an ideal which may be approached by the use of such refined cleaning techniques as positive-ion bombardment of single crystals. Electrical and electronic characteristics of semiconductors, said Dr. Wolsky, are directly related to the purity and composition of the material. He is studying the surface properties of semiconductors, as well as zirconium and titanium, as a senior research scientist with Raytheon Corp. Being mindful of the special interests of his audience, Dr. Wolsky described his experimental techniques in detail, including the construction and function of the all-quartz microbalance, the traps and series mercury diffusion pumps, the ionization gage for vacuum measurements, and a sensitive mass spectrometer known as the Omegatron for analysis of gases in the evacuated space. The principle of the Omegatron is similar to that of the cyclotron ion accelerator in that it provides a spiral magnetic field for deflection of ions formed by an ionizing beam. A sensitive microammeter measures currents as low as 10^{-14} to 10^{-15} amp.

Dr. Wolsky's talk was a highlight of the two-day meeting devoted largely to the committee's bread-and-butter work of developing standard tests and specifications.

A new approach is being taken to sharpen the measurement of interface impedance of tube cathodes (F 300) by the development of procedures for evaluation of equipment for making the measurement.

A specification for mica bridge has been approved by the committee for recommendation to the Society, and revisions are in progress on the aluminum oxide specification (F 7).

Means for measuring burr on strip and establishment of thickness tolerances will form the basis for revision of several of the specifications for strip (F 1, 2, 3, and 4).

The committee also serves the incandescent lamp industry and plans to issue a new specification covering nickel alloys used as lead wire in lamps. This will replace the former specification F 175, which has been withdrawn as obsolete.

Production of high-reliability tubes requires, among other things, a vacuum tightness approaching absolute perfection. In order to achieve this, it is necessary first to be able to observe the presence of leaks in seals of metals to ceramics or glass. Under auspices of the metallic-nonmetallic seals subcommittee, a meeting to discuss this problem was held, representing also the American Vacuum Society and the Joint Electron Device Engineering Council. It was agreed that a project on measurement of leaks should be established in Subcommittee V, to which invitations for participation and cooperation by other organizations would be issued.

A substantial portion of the 140 people who attended the meetings were concerned with problems of cleaning electronic parts and materials. The subcommittee on control of contaminants represents the tube industry, the semiconductor industry, as well as drugs and pharmaceuticals. There are about 15 to 20 drafts of methods and recommended practices being evaluated in the subcommittee. These cover measurements on ultra-pure or so-called "aggressive" water, solvents, sorbed gases, surfaces, and air-borne particulate matter.

This is one of a series of photographs from a collection compiled by Prof. Jasper O. Draffin and displayed in the Arthur N. Talbot Laboratory, University of Illinois.

HEINRICH HERTZ (1857–1894). Born in Germany, Heinrich Hertz became Professor of Physics at Polytechnic Institute at Karlsruhe and later at the University of Bonn. He discovered "Hertzian waves"—the basis for the development of radio transmission. He discussed various forms of energy and the change from one form to another. Hertz also developed the classical treatment of stresses in rollers and spheres under load.

"A doubt which makes an impression on our mind cannot be removed by calling it metaphysical; every thoughtful mind as such has needs which scientific men are accustomed to denote as metaphysical. Moreover . . . it is possible to show what are the sound and just sources of our needs. It is true we cannot a priori *demand from nature simplicity, nor can we judge what in her opinion is simple. But with regard to images of our own creation we can lay down requirements."*

Principles of Mechanics

Glass Research at the National Bureau of Standards

ALTHOUGH glassmaking is an ancient profession, research into the properties of glass began only in the last two decades of the nineteenth century. The fundamental nature of glass structure is, however, still not clearly understood; development of new types of glass having specified optical, thermal, mechanical, or chemical properties is still largely an empirical procedure.

With a better understanding of the nature of glass should come enhanced ability to develop new types of glass for specific uses. A broad program of glass research at the National Bureau of Standards is exploring in three areas: fundamental studies of glass; development of special glasses, particularly for military uses; and investigation of methods for producing optical glass. The last two are almost entirely supported by defense agencies.

The Bureau's program of fundamental research on the properties and structure of glass is concerned with the glass-forming process, the nature of the vitreous and supercooled states, viscosity and surface tension at elevated temperatures, strength and elastic moduli over a wide range of temperatures, surface properties, and the bulk structure of glass. Other investigations deal with the behavior of glass in unusual engineering applications, the development of special glasses for precision optical instruments, and standard glasses with closely measured physical properties.

Glass Stability

Fundamental studies of glass-forming regions of simple ternary systems are helping to explain the nature of glass. For example, analysis of glass stability in terms of phase diagrams has shed additional light on the glass-forming process and on the structure of multicomponent glasses, this work indicating that distinct chemical entities exist in glass. Also useful is the discovery that stable glasses are usually found in areas of a phase diagram where the liquidus curve or surface is flat—an indication of a highly dissociated compound.

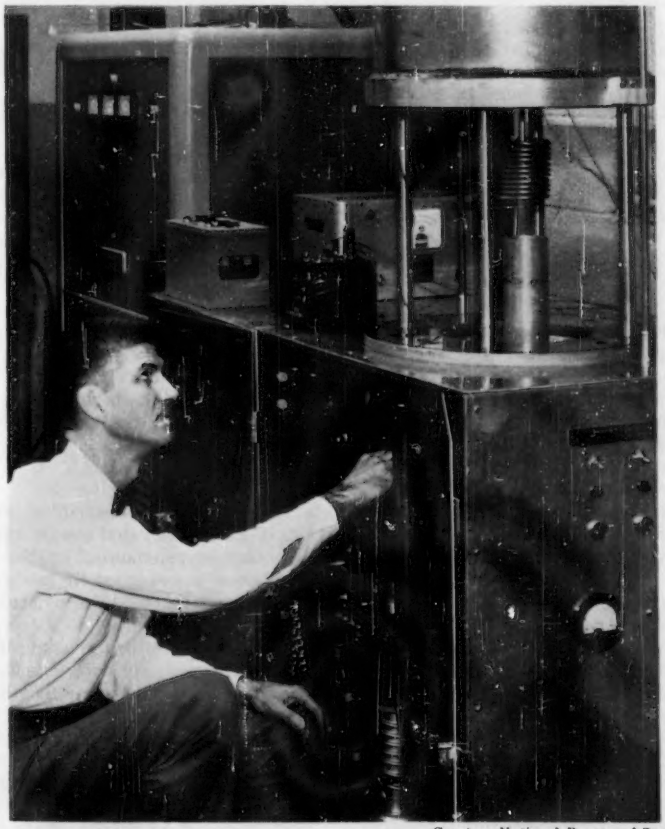
Since stable glass formation is directly opposed to crystallization, or devitrification, the factors affecting crystallization are under study. One of these factors is the liquidus temperature—the highest temperature at which molten glass and the crystalline phase can coexist in equilibrium; another is the rate of crystal growth at various temperatures; a third is the time required for crystals to nucleate. A comparison of liquidus data with observed glass-forming ability aids in understanding glass structure.

Entropy, Order, and Disorder

Studies of the excess entropy of glass should also provide a better understanding of the vitreous state. Excess entropy is a measure of the greater molecular disorder of glass as compared with corresponding crystals of the same composition.

Efforts are under way to measure excess entropy in two ways on glasses for which stoichiometrically corresponding crystals also exist. One method is to measure specific heat over the temperature range from just above the melting point down as near as possible to absolute zero. The entropy loss thereby determined over this range for the glass, as compared with that for the crystal, gives values for the residual entropy. A precision low-temperature adiabatic calorimeter for part of these measurements is nearing completion. It will be supplemented with a high-temperature drop calorimeter.

In the second method, vapor pressures are being measured as a function of temperature for substances in vitreous



Courtesy National Bureau of Standards

Oscillating cup viscometer developed at the National Bureau of Standards for measuring viscosity and surface tension of glass at temperatures above 2000 C. In the upper foreground is the vacuum chamber, raised to show the induction heating coil surrounding the oscillating cup. W. Cappa is making adjustments on the vacumm system in the lower foreground. In the background is the high frequency generator.

and crystalline states. The entropies of vaporization obtained from these measurements give values for the excess entropy of a particular specimen of glass. Such measurements on vitreous arsenic trioxide have led to interesting side results indicating an extremely low condensation coefficient.

Transition Temperature

As a mark of the transformation between the vitreous and the supercooled liquid states, glass transition temperatures are being investigated. Measurements of these temperatures as a function of composition in two-component systems have suggested that certain systems form glasses only at stoichiometric ratios of the compounds, and a greater number form glasses at non-stoichiometric ratios.

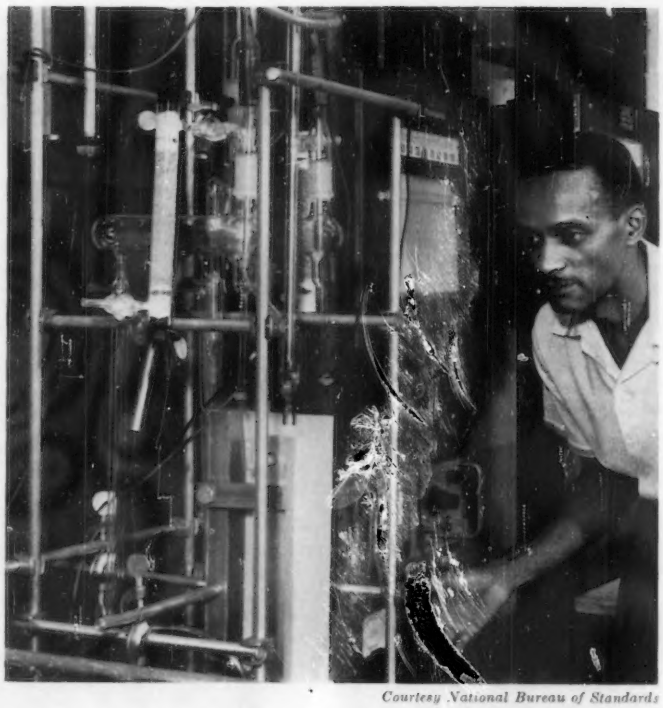
Measured differences in thermal expansion coefficients for glass-forming substances above and below their glass transformation temperatures have been compared with values predicted theoretically from their viscosity-temperature relations. Results indicate that in most glasses, including silicates, the molecular structure may not change drastically with temperature in the transition region. In borate and nitrate glasses, however, the thermal expansion data do not conflict with the concept of structural changes.

Ion Migration

Migration of ions in vitreous silicates gives many clues to both the bulk and surface structures of glass. Since many properties of glass are highly dependent upon the ions at the surface, this area of study promises to yield much information of both theoretical and practical value.

Under study at the present time is the migration of mobile ions, such as alkali, through the glass under the influence of a concentration gradient created by subjecting a glass surface to water or other environment containing diffusion sinks for alkali. The experimental study of the diffusion kinetics is performed by a coulometric method that simultaneously determines the amount of alkali released and removes any corrosion products, to maintain a constant pH. The data obtained are compared with mobility data derived from electrical conductivity measurements and analyzed with respect to various theoretical diffusion models.

Of further interest are the details of the exchange mechanism in this process —in particular, how the water constituents enter the structure of the glass. Methods are being developed not only to observe the kinetics of the net-diffusion process but also to obtain successive concentration profiles through the glass at various stages of the diffusion process.



Courtesy National Bureau of Standards

Electrophoretic cell used in the study of the kinetics of the release of alkali from glass. The coulometric method used here by C. Pearson determines the amount of alkali released.

High-Temperature Viscosity and Surface Tension

Methods are being devised for measuring viscosity and surface tension at temperatures up to 2000 C. Such data will help to improve production methods and also our fundamental understanding of liquids at high temperature. A room-temperature model of an oscillating-cup viscometer has already been built and calibrated with oils of suitable viscosity. A high-temperature version is now under construction and will soon be completed.

Strength of Glass at Elevated Temperatures

Knowledge of the mechanical properties of glass at elevated temperatures is necessary for aeronautical applications. The Bureau is measuring the modulus of rupture and the modulus of elasticity from room temperature to a temperature near the softening point of the glass. The study includes the effect of prolonged heating on the strength and on the rate at which specimens of both annealed and tempered glass deform under load.

Only those glasses that are available in commercial quantities, or that have been produced as polished plate in at least pilot-plant quantities, have been chosen for this study. Although these are few in number, they do cover a wide range of physical properties.

A study of test methods and methods of specimen preparation has been completed. Strength tests on six types of glass-soda-lime-silica, two borosilicates, alumino silicate, 96 per cent silica, and fused silica are almost complete.

Special Optical Glasses

The increasing use of infrared devices in the military fields of target detection, fire control, missile guidance, and aerial reconnaissance creates a demand for improved optical materials. To develop multicomponent glasses having particular infrared transmission properties, the Bureau has been investigating the size, shape, and location of the glass-forming areas in the phase diagrams of simple two- and three-component systems. The physical and optical properties of the simple glasses can be correlated with composition to furnish clues to the nature and arrangement of the atomic and molecular units composing the glass structure.

The effects of small amounts of water in the internal structure of glass have been largely neglected in the past. The presence of this water is strongly evident in the infrared spectra of practically all glasses. If glass is to serve as an infrared material at wavelengths beyond 2.75 μ, means must be found to eliminate or reduce the water content. Work in this area has been in progress for some time. Glasses have been made in silicate, germanate, calcium alumi-

nate, and tellurite systems, and many of their properties determined.

Recently it has been found that the water band absorption is greatly reduced by the use of fluorides as an ingredient of the batches from which the glasses are melted. While the method has been used only on a laboratory scale, it appears to be usable on melts of any size.

Standard Sample Program

The Bureau has for a number of years made available standard samples of glass to be used as checks on the accuracy of chemical analysis of glass. Two additional types of standard samples are now being considered. One will be a series of glasses, representative of important commercial types, that can be used to calibrate and standardize instruments for measuring the properties of glass. The second will be a series of high purity containing one, two, or three components. These glasses will be used to compare results between laboratories, especially in studies of structure and constitution.

A soda-lime-silica glass which is representative of a widely used commercial composition is now being studied for use as a standard of viscosity and surface tension for molten glass. In the lower temperature range, up to 1450 C, a calibrated rotating-cylinder viscometer is used. The surface tension of this glass will also be determined over a similar temperature range. Additional types of glass, representative of those commercially available, will soon be obtained to extend the work on viscosity and surface tension calibrations as soon as the determinations on the soda-lime-silica glass are complete.

Plastics Committee of ISO To Meet in Prague in October

THE TENTH ANNUAL meeting of the Plastics Technical Committee of the International Standards Organization (ISO 61) will be held in Prague, Czechoslovakia, October 17–22. Delegates from more than 15 nations are expected to attend.

It was pointed out by W. E. Brown of The Dow Chemical Co., U.S. National Committee chairman, that the United States exported almost a billion pounds of plastics last year—15 per cent of its total production. Efficient international trade in plastics is promoted by the work of the ISO.

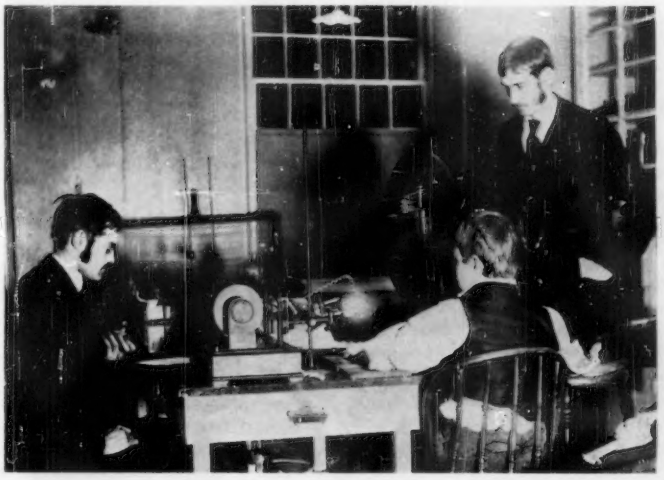
The committee consists of nine working groups. Five of the groups work on mechanical, chemical, thermal, environmental, and electrical testing, and the others work on nomenclature, conditioning, molding and fabricating, and materials specifications.

The USA National Committee for ISO 61 functions as a subcommittee of ASTM Committee D-20 on Plastics. It looks to the entire Committee D-20 for advice in establishing a national consensus in ISO 61 matters. The United States, through the American Standards Assn., holds the secretariat for ISO 61.

ISA Conference and Exhibit Set for September

THE 15th ANNUAL Conference and Exhibit of the Instrument Society of America will be held in New York City, September 26–30, 1960. For this event, more than 200 papers are planned, dealing with all phases of measurement, communication, and control. Also, a number of special events will be held, in which the situation confronting industry, government, education, and research organizations will be subject to penetrating discussions with the aim of formulating programs for decisive action. Further information can be obtained from ISA headquarters at 313 Sixth Ave., Pittsburgh 22, Pa.

X-Rays in Action



Wilder Laboratory of Physics, Dartmouth College, Hanover, N. H.

THE WORLD of classical physics exploded violently within the space of a single year, which saw the discovery of X-rays, radioactivity, and the electron. Röntgen's famous paper "On a New Kind of Rays" was communicated in Würzburg on December 28, 1895. Within ten days excited scientists had cabled the news to all parts of the world. The medical significance was immediately realized. It has been shown by Cipollaro (*Radiology* 45, 1945, p. 555) that the first Röntgenograms depicting a pathological condition were made in the United States by Prof. Edwin B. Frost of Dartmouth College, Hanover, N. H., on February 3, 1896. Thanks to a local photographer, Mr. H. H. Langill, who assisted in the experiment, we also have an actual photograph of the scene that day in the Physics Laboratory at Reed Hall in the College. On the left sits Professor Frost, watch in hand, timing the 15 to 20-min exposure. The apparatus consists of a Puluj tube—a type of Crookes tube containing phosphorescent salts—activated by an induction coil and Grove batteries. The patient, young Edward McCarthy, has his arm (with fractured radius and ulna) under the tube. On the right, watching history in the making, is Dr. Gilman Frost, the medical man on the spot. Photographs of nineteenth century laboratories are rare; one depicting such an important event is quite exceptional.

Text by Professor Derek J. de Solla Price, Yale University.
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Introduction of the Tex System for Designation of Yarn Number

A PLAN for the orderly introduction of the single system of numbering yarns made from all types of fibers is being introduced to the textile industry in most of the countries of the world. United States participation is needed to keep our industry abreast of this significant development.

Yarn number represents the "size," "fineness," or, more accurately, the relationship between weight and length of a yarn. The tex system has been chosen to replace the many conflicting systems now used, after extended study by the Technical Committee on Textiles of the International Organization for Standardization (ISO/TC 38). Delegates representing the textile industries of 21 nations including the United States and four international textile associations participated in the study and unanimously adopted this proposal.

It is proposed to make the changeover in three easy stages over a period of years. The action to be taken in each stage will be given here. The first stage is to start in 1960 and run until the trade is thoroughly familiar with the new system. Dates for the second and third stages will be set when the trade becomes ready for them.

Three Stages of Action

First Stage

This stage is designed to familiarize everyone working in the textile industry with tex numbers. The existing yarn count systems will continue in use, but a corresponding rounded tex number will be given in parentheses after the traditional yarn count or yarn number—for example: 18 cotton count (32 tex), 48 worsted count (18 tex), 100 denier (11 tex).

During this stage the rounded tex numbers in parentheses are illustrative or explanatory and have no legal standing. They cannot be used as the basis of claims or other disputes, which must be based on the traditional yarn numbers. A note to this effect may be stamped on contracts or other documents where this is felt to be desirable.

Second Stage

Commercial transactions and manufacturing operations will be shifted to tex numbering. The equivalent traditional yarn number or count will be given in parentheses after the tex number—for example: 32 tex cotton yarn will be written 32 tex (18.5 cotton count); 18 tex worsted yarn will be written 18 tex (48 worsted count).

Third Stage

The traditional yarn number in parentheses will be deleted; only tex numbers will be given.

Action to be Taken Now

In view of the benefits to be derived from the general use of a single yarn numbering system throughout the industry, all textile trade associations are urged to endorse the plan for introduction of the tex system and to recommend participation in it by their members. Manufacturers, distributors, testing and research laboratories, and individuals throughout the industry are urged to give rounded equivalent tex numbers in parentheses following the traditional numbers or counts wherever they appear on orders, invoices, tags, reports, in trade literature, and in technical publications.

The rounded tex numbers can be obtained readily from short tables relating them to the numbers or counts in the system now used. Condensed tables are appended to this report for cottons, worsted, woolen, and denier numbers or counts, with directions for their use. The tex number of a yarn, fiber, or other strand is defined as the weight in grams of one kilometer of yarn. Constants have been calculated for converting yarn numbers or counts of all systems currently in use to tex numbers. For the present, however, only rounded equivalent numbers need be used.

The ISO Committee, developing plans for the introduction of the tex system, has suggested that as far as possible the rounded equivalent tex numbers listed in Table II of the Appendix should be used in preference to other intermediate numbers or to the exact tex numbers. The preferred numbers have been carefully selected to cover the entire range needed for commercial yarns in a series of steps that, in general, reflect variations observed in practical spinning operations. In the second stage, when yarns are numbered in the tex system, intermediate values can, of course, be used whenever tradition or customer's requirements indicates this to be desirable.

Scope and Benefits of the Tex System

Since the tex number is also applicable to yarn intermediates, it can be used for laps, slivers, and rovings as well as yarns. It can also be used for individual fibers; the millitex unit can be used to avoid low numbers.

The success of the analogous denier system gives assurance that the proposed tex system is workable. The tex system has already been used successfully in local installations, both in cotton spinning laboratories and in manufacturing units, so that no one need have any hesitation about its suitability as a yarn numbering system.

Adoption of a single universal system for numbering yarns made from any fiber will have the following advantages:

1. The various yarn systems now in use with different fibers—for example, English cotton counts, French cotton counts, metric counts, Yorkshire woolen skeins, American woolen runs, English worsted counts—will all be replaced with the tex system, eliminating time spent in converting units from one system to the other and avoiding mistakes that occur when technicians are forced to think in unfamiliar units.

2. Efficiency in mills spinning yarns from any fiber will be increased. Picker laps, slivers, rovings, and yarns will all be numbered in the same units, thus facilitating the calculation of drafts at all stages of spinning and eliminating confusion due to changing systems between laps and slivers, slivers and rovings, tops and gills, rovings and yarns.

3. Operating procedures will be simplified in mills simultaneously spinning yarns from fibers numbered in different systems, for example, wool and man-made fibers on both the worsted and woolen systems. Sales of these

products to different customers will also be simplified.

4. The buying and selling of yarns that must meet specifications given in different traditional numbering systems will be simplified by eliminating the time spent in converting and checking results.

5. Efficiency in cost accounting and inventory control will be increased, since all yarns, regardless of the fiber used, will be based on the same yarn numbering system.

6. Fabric design work will be simplified, since the same amount of yarn, that is, the same length of yarn of a given number or count, will be needed to make the same weight of fabric, regardless of the fibers involved.

7. Calculation of the resultant count of all plied yarns that are numbered in indirect numbering systems will be much easier, since with tex numbers the equivalent single number can be calculated by simple addition.

8. Efficiency of quality control and cost comparisons will be improved, since all derived or calculated yarn properties such as breaking tenacity or lea product will be in the same units regardless of fiber used.

9. It will be easier to interpret and use the findings of textile research workers published anywhere in the world.

10. Any spinning or blend study involving the number of fibers in a yarn will be easier to make, since the yarn and the fibers used will both be numbered in the same or closely related systems.

11. The time spent in technical textile schools teaching and practicing the use of various yarn numbering systems will be eventually eliminated. This time will be available for teaching other important subjects.

12. The United States textile industry will avoid being placed at a further disadvantage in production costs with respect to competition from foreign countries who are expected to adopt the tex yarn numbering system fairly soon.

13. In addition to the ultimate lower costs resulting from all these increased efficiencies each textile scientist or executive will have the personal satisfaction of promoting the use of the universal yarn numbering system in his own company and trade association and of knowing that, at the cost of some relatively transient personal difficulty, he is contributing to the advancement of the textile industry for the benefit of all future generations.

Conclusion

Agreement on the tex system for yarn numbering is a notable achievement in international standardization in a field where standardization is long overdue. It merits the support of every person, organization, and company interested in the long-range good of the textile industry.

It is urged that everyone in the textile industry participate in the general educational program leading to the introduction of the tex yarn numbering system in his part of the industry.

Discussions of the tex yarn numbering system have appeared in textile journals in the United States and in foreign countries from time to time. Anyone desiring more information on this international development should consult his own technical experts, his ASTM representative, or should refer to the References listed below.

References

(1) Anon. letter to the editor reporting use of the tex system in the large Alpargartos Cotton Mills in Argentina and Uruguay, *Textile Age*, Vol. 8, p. 108 (1944).

(2) Tentative Recommended Practice for Use of Tex System to Designate Linear Density of Fibers, Yarn intermediates, Yarns, and Other Textile Materials, ASTM Designation: D 861 – 58 T, 1958 Book of ASTM Standards, Part 10, p. 347.

(3) ASTM Yarn Numbering Conversion Table. This Table gives exact tex equivalents of normal yarn counts for all traditional yarn numbering systems. Appendix III of Compilation of ASTM Standards on Textile Materials, published annually.

(4) A. W. Bayes, "Tex Universal Yarn Numbering System," *Journal Textile Inst.*, Vol. 48, p. 255 (1957).

(5) Canadian Advisory Committee on ISO/TC 38 "Textiles—Introduction of the Tex Yarn Numbering System," *Canadian Textile Journal*, Vol. 76, pp. 59–63 (Dec. 11, 1959).

(6) J. Corbiére, "The International Numbering of Yarns and Threads," *Textile Research Journal*, Vol. 23, p. 946 (Dec., 1953).

(7) Deutsche Normen, DIN 60905 (Official German Standard), "The Tex System for the Numbering of Textile Fibers, Yarns, and Fabrics," Melliand Textil-Berichte, Vol. 38, p. 642 (1957) (In German).

(8) R. W. Forrester, "Yarn Counts—Proposed Universal System," *Journal Textile Inst.*, Vol. 40, S8-12 (1949).

(9) J. W. S. Hearle, "Tex Universal Yarn Numbering System," *Journal Textile Inst.*, Vol. 48, pp. 416–7 (1957).

(10) K. Henschel, "Simplification of Yarn Numbering, Preparation for the Introduction of the International Numbering of Yarns in Germany," *Textile Research Journal*, Vol. 25, p. 140 (1955).

(11) International Cotton Federation, "Approval of the Tex Yarn Numbering System for Cotton and Allied Textile Industries," *Textile Mercury and Argus*, Vol. 139, p. 360 (1958).

(12) H. L. Röder, "The Tex System Adopted as the Universal Numbering System for Yarns and Fibers," *Enka and Breda Rayon Review*, Vol. 10, p. 133 (1956).

(13) L. Szponder, "Tex—A Universal Yarn Numbering System," *Textile Industries*, Vol. 122, p. 149 (1958).

(14) A. G. Scroggie, "The Tex Universal Yarn Numbering System," *Textile Research Journal*, Vol. 28, p. 330 (1958).

(15) Spanish Government, Promulgation of the Tex System for Numbering Yarns made from all Fibers (1946) (In Spanish).

(16) B. L. Whittier, "Tex—A New Yarn-Numbering System," *Textile World*, Vol. 107, p. 88 (Aug., 1957).

(17) The Tex System of Yarn Counting, Recommendation to all members of the Federation of Master Cotton Spinners Associations Ltd., The Yarn Spinners Association and the Cotton Yarn Doublers Association in the United Kingdom, to proceed with the adoption of the Tex System, pamphlet, Federation of Master Cotton Spinners Associations Ltd., Manchester 2, England.

W. D. Appel, chairman,
ASA Committee L23, U. S. representative on ISO/TC 38 on Textiles.

B. L. Whittier, chairman,
ASTM Committee D-13 on Textile Materials.

APPENDIX

CONVERSION TABLES

Conversion tables giving the rounded equivalent tex numbers for various ranges of English Cotton Count (Table III), English Worsted Count (Table IV), American Woolen Run (Table V), and Denier Number (Table VI), together with instructions for their use, are given in this Appendix.

Tables for other systems can be prepared by means of the factors, given in Table I. Factors for a number of other systems can be found in Draft ISO Recommendation (Document ISO/TC 38 (Sc 4-1) 210).

TABLE I.—CONVERSION FACTORS.

Divide	To Get Tex Number By
Denier No...	9
Spyndle No.	0.02903
4960.5.....	Asbestos cut[a]
590.54....	Cotton count (English)[b]
4960.5.....	Glass cut[c]
1653.5.....	Linen cut[d])
1000.0.....	Metric No.[e]
310.03....	Woolen run (American)[f]
885.8.....	Worsted count (English)[g]
or	
Multiply	By
Denier No..	0.1111
Spyndle No.	34.45

[a] Asbestos cut, Naa, equals 100-yd hanks per lb. [b] English cotton count, Nec, equals 840-yd hanks per lb. [c] Glass cut, Ng, equals 100-yd hanks per lb. [d] Linen cut, Nel, equals 300-yd hanks per lb. [e] Metric number, Nm, equals kilometers per kilogram. [f] American woolen run, Nar, equals 1600-yd hanks per lb. [g] English worsted count, Ne, equals 560-yd hanks per lb.

To prepare a conversion table, use the appropriate factor from Table I to calculate the equivalent traditional value for

TABLE II.—RECOMMENDED ROUNDED TEX NUMBERS.[a]

Range of Tex Number		Recommended Rounded Tex Number	Range of Tex Number		Recommended Rounded Tex Number
Above	Up To and Including		Above	Up To and Including	
9.4	9.8	9.6	31	33	32
9.8	10.25	10	33	35	34
10.25	10.75	10.5	35	37	36
10.75	11.25	11	37	39	38
11.25	11.75	11.5	39	41	40
11.75	12.25	12	41	43	42
12.25	12.75	12.5	43	45	44
12.75	13.5	13	45	47	46
13.5	14.5	14	47	49	48
14.5	15.5	15	49	51	50
15.5	16.5	16	51	54	52
16.5	17.5	17	54	58	56
17.5	18.5	18	58	62	60
18.5	19.5	19	62	66	64
19.5	20.5	20	66	70	68
20.5	21.5	21	70	74	72
21.5	22.5	22	74	78	76
22.5	23.5	23	78	82	80
23.5	24.5	24	82	86	84
24.5	25	25	86	90	88
25.5	27	26	90	94	92
27	29	28	94	98	96
29	31	30	98	102.5	100

[a] Reproduced from the draft ISO Recommendation ISO/TC 38(SC 4-1)210, section 3.2. The decimal multiples and fractions of the rounded values indicated in this table are valid for the decimal multiples and fractions of the corresponding ranges.

The rounded tex number appropriate to any number in a traditional system can be obtained by following the procedure set forth in the draft ISO Recommendation, but it is more convenient to use a table in which the limits of the rounded tex numbers have been converted into those of a traditional system.

the limiting range of the recommended rounded tex units listed in Table II. Each calculated value forms the upper limit of one range and the lower limit of the next range as shown in Tables III through VI.

Use of Table III for Conversion of English Cotton Count into Rounded Tex Number

In the left-hand columns of this table, find the range that includes the cotton count under consideration. On the same line as the selected range and to the right of it, find the corresponding rounded tex number. This is the number to be placed in parentheses after the traditional number during the first stage of the introduction of the tex system.

Example.—Cotton count 21 falls in the range of 20.36 to 21.87. The corresponding rounded tex number is 28. The recommended notation for this yarn during the first stage of the introduction of tex yarn numbers is accordingly: cotton count 21 (28 tex), or, using the European abbreviation, Nec 21 (28 tex).

* * *

When required, the values below 10 tex and above 100 tex can be derived from the same table simply by multiplying the values by 10 or dividing them by 10. When doing this, it should be noted that the decimal point in the left columns moves in the opposite direction to that in the right column.

Examples:

Cotton Count		Recommended Round Tex Number
Beginning With	Up to but Not Including	
20.36	21.87	28
2.036	2.187	280
203.6	218.7	2.8

Use of Table IV for Conversion of English Worsted Count into Rounded Tex Number

In the left-hand columns of this table, find the range that includes the worsted number under consideration. On the same line as the selected range and to the right of it, find the corresponding rounded tex number. This is the number to be placed in parentheses after the traditional number during the first stage of the introduction of the tex system.

Example.—Worsted count 32 falls in the range of 30.54 to 32.80. The corresponding rounded tex number is 28. The recommended notation for this yarn during the first stage of the introduction of tex yarn numbers is accordingly: Worsted count 32 (28 tex), or, using the European abbreviation, Ne 32 (28 tex).

* * *

When required, the values below 10 tex and above 100 tex can be derived from the same table simply by multiplying the values by 10 or dividing them by 10. When doing this, it should be noted that the decimal point in the two left columns moves in the opposite direction to that in the right column.

Examples:

Worsted Count		Recommended Rounded Tex Number
Beginning With	Up to But Not Including	
30.54	32.81	28
3.054	3.281	280
305.4	328.1	2.8

TABLE III.—CONVERSION OF ENGLISH COTTON COUNT INTO ROUNDED TEX NUMBER.

For Use During the First Stage of Introduction of the Tex System.

Tex = 590.5/Cotton count.

Cotton Count[a]		Recommended Rounded Tex Number
Beginning With	Up to But Not Including	
57.59	59.64	10
54.91	57.59	10.5
52.47	54.91	11
50.24	52.47	11.5
48.19	50.24	12
46.30	38.19	12.5
43.73	36.30	13
40.72	43.73	14
38.09	40.72	15
35.78	38.09	16
33.74	35.78	17
31.92	33.74	18
30.28	31.92	19
28.80	30.28	20
27.46	28.80	21
26.24	27.46	22
25.13	26.24	23
24.10	25.13	24
23.16	24.10	25
21.87	23.16	26
20.36	21.87	28
19.05	20.36	30
17.90	19.05	32
16.87	17.90	34
15.96	16.87	36
15.14	15.96	38
14.41	15.14	40
13.74	14.41	42
13.13	13.74	44
12.57	13.13	46
12.05	12.57	48
11.58	12.05	50
10.94	11.58	52
10.19	10.94	56
9.524	10.19	60
8.947	9.524	64
8.436	8.947	68
7.980	8.436	72
7.571	7.980	76
7.201	7.571	80
6.866	7.201	84
6.561	6.866	88
6.282	6.561	92
6.026	6.282	96
5.759	6.026	100
5.758	5.759	105

[a] Cotton count (Nec) = 840-yd hanks per lb.

Use of Table V For Conversion of American Woolen Run into Rounded Tex Number

In the left-hand columns of this table, find the range that includes the woolen run number under consideration. On the same line as the selected range and to the right of it, find the corresponding rounded tex number. This is the number to be placed in parentheses after the traditional number during the first stage of the introduction of the tex system.

Example.—American woolen run 11 falls in the range 10.691 to 11.483. The corresponding rounded tex number is 28. The recommended notation for this yarn during the first stage of the introduction of tex yarn numbers is accordingly: Woolen run 11 (28 tex), or, using the European abbreviation, Nar 11 (28 tex).

TABLE IV.—CONVERSION OF ENGLISH WORSTED COUNT INTO ROUNDED TEX NUMBER.

For Use During the First Stage of Introduction of the Tex System.

Tex = 885.8/worsted count.

English Worsted Count[a]		Recommended Rounded Tex Number
Beginning With	Up to But Not Including	
82.400	86.419	10.5
78.737	82.400	11
75.387	78.737	11.5
72.310	75.387	12
69.474	72.310	12.5
65.614	69.474	13
61.089	65.614	14
57.148	61.089	15
53.684	57.148	16
50.617	53.684	17
47.881	50.617	18
45.425	47.881	19
43.209	45.425	20
41.200	43.209	21
39.368	41.200	22
37.693	39.368	23
36.155	37.693	24
34.737	36.155	25
32.807	34.737	26
30.544	32.807	28
28.574	30.544	30
26.842	28.574	32
25.308	26.842	34
23.940	25.308	36
22.712	23.940	38
21.604	22.712	40
20.600	21.604	42
19.684	20.600	44
18.846	19.684	46
18.077	18.846	48
17.368	18.077	50
16.403	17.368	52
15.272	16.403	56
14.287	15.272	60
13.421	14.287	64
12.654	13.421	68
11.970	12.654	72
11.356	11.970	76
10.802	11.356	80
10.300	10.802	84
9.842	10.300	88
9.423	9.842	92
9.038	9.423	96
8.641	9.038	100
8.240	8.641	105

[a] English worsted count (Ne) = 560-yd hanks per lb.

* * *

When required, the values below 10 tex and above 100 tex can be derived from the same table simply by multiplying the values by 10 or dividing them by 10. When doing this, it should be noted that the decimal point in the two left columns moves in the opposite direction to that in the right column.

Examples:

American Woolen Run		Corresponding Rounded Tex Value
Beginning With	Up to But Not Including	
10.691	11.483	28
1.0691	1.1483	280
106.91	114.83	2.8

TABLE V.—CONVERSION OF AMERICAN WOOLEN RUN INTO ROUNDED TEX NUMBER.

For Use During the First Stage of Introduction of the Tex System.

Tex = 310.03/American woolen run.

American Woolen Run[a]		Recommended Rounded Tex Number
Beginning With	Up to But Not Including	
30.247	31.633	10
28.840	30.247	10.5
27.558	28.840	11
26.386	27.558	11.5
25.309	26.386	12
24.316	25.309	12.5
22.965	24.316	13
21.381	22.965	14
20.002	21.381	15
18.790	20.002	16
17.716	18.790	17
16.758	17.716	18
15.899	16.758	19
15.123	15.899	20
14.420	15.123	21
13.779	14.420	22
13.193	13.779	23
12.654	13.193	24
12.158	12.654	25
11.483	12.158	26
10.691	11.483	28
10.001	10.691	30
9.395	10.001	32
8.858	9.395	34
8.379	8.858	36
7.949	8.379	38
7.562	7.949	40
7.210	7.562	42
6.890	7.210	44
6.596	6.890	46
6.327	6.596	48
6.079	6.327	50
5.741	6.079	52
5.345	5.741	56
5.000	5.345	60
4.697	5.000	64
4.429	4.697	68
4.190	4.429	72
3.975	4.190	76
3.781	3.975	80
3.605	3.781	84
3.445	3.605	88
3.298	3.445	92
3.164	3.298	96
3.024	3.164	100
2.884	3.024	105

[a] American woolen run (Nar) = 1600 yd hanks per lb.

Use of Table VI For Conversion of Denier Number Into Rounded Tex Numbers

In the left-hand columns of this table find the range that includes the denier number under consideration. On the same line as the selected range and to the right of it, find the corresponding rounded tex number. This is the number to be placed in parentheses after the traditional number during the first stage of the introduction of the tex system.

Example.—The denier number 250 falls in the range of 243 to 261. The corresponding rounded tex number is 28. The recommended notation for this yarn during the first stage of the introduction of tex yarn numbers is accordingly: 250 denier (28 tex), or, using the European abbreviation, Td 250 (28 tex).

TABLE VI.—CONVERSION OF DENIER NUMBER INTO ROUNDED TEX NUMBER.

For Use During the First Stage of the Introduction of the Tex System.

Tex = Denier number/9.

Denier Number[a]		Recommended Rounded Tex Number
Beginning With	Up to But Not Including	
88.2	92.25	10
92.25	96.75	10.5
96.75	101.2	11
101.2	105.7	11.5
105.7	110.2	12
110.2	114.7	12.5
114.7	121.5	13
121.5	130.5	14
130.5	139.5	15
139.5	148.5	16
148.5	157.5	17
157.5	166.5	18
166.5	175.5	19
175.5	184.5	20
184.5	193.5	21
193.5	202.5	22
202.5	211.5	23
211.5	220.5	24
220.5	229.5	25
229.5	243	26
243	261	28
261	279	30
279	297	32
297	315	34
315	333	36
333	351	38
351	369	40
369	387	42
387	405	44
405	423	46
423	441	48
441	459	50
459	486	52
486	522	56
522	558	60
558	594	64
594	630	68
630	666	72
666	702	76
702	738	80
738	774	84
774	810	88
810	846	92
846	882	96
882	922.5	100
922.5	967.5	105

[a] Denier number (Td) = grams per 9000 meters.

* * *

When required, the values below 10 tex and above 100 tex can be derived from the same table simply by multiplying the values by 10 or dividing them by 10. When doing this it should be noted that the decimal point in the two left columns moves in the same direction as in the right column.

Examples:

Denier Number		Corresponding Rounded Tex Value
Beginning With	Up to But Not Including	
243	261	28
2430	2610	280
24.3	26.1	2.8

Random Samples. . .

FROM THE CURRENT MATERIALS NEWS

Million psi Pressure Gage?

The National Bureau of Standards has expanded its pressure standards program to include development of improved standards and techniques for measuring very high pressures. Changes in the properties of materials will be studied to provide more precisely determined calibration points on the pressure scale.

High pressures offer great promise in treating new materials to meet very severe requirements. For example, high pressures cause chemical changes that form new compounds such as polyethylene and boron nitride, and crystalline changes such as occur when graphite is changed to diamond, or quartz to Coesite.

Remarkable changes in physical properties often appear when materials are subjected to high pressures. Some familiar electrical insulators become semiconductors, and some familiar semiconductors become conductors. Brittle substances such as bismuth and quartz become ductile. Tungsten carbide more than doubles in strength when subjected to a hydrostatic pressure of 400,000 psi.

Above 500,000 psi, experimental techniques differ from those at lower pressures because nearly all fluid materials become solid. For example, at room temperature water solidifies at 140,000 psi, mercury at 180,000 psi, and nitrogen at 400,000 psi. In studying materials at very high pressures, the pressure-transmitting media now used are solids that have low shear strength, such as indium, lead, tin, silver chloride, talc, or pyrophyllite.

The Bureau hopes to extend to higher pressures those techniques that are now used to generate and measure pressures below 200,000 psi. These pressures can now be measured by dead-weight-loaded pistons. Instead of using packings, the clearance between piston and cylinder is made so small that leakage is kept within a few cubic inches per month. This type of apparatus may be found usable, with a fluid pressure medium, at pressures as high as 350,000 or 400,000 psi.

In measuring pressures above 200,000 psi, scientists now refer to approximately known pressures at which there are changes in phase, volume, or electrical resistance of certain materials. The resistance of bismuth, for example, changes abruptly at 365,000, 385,000, and 1,700,000 psi; of thallium at 630,000; and of barium at 1,100,000 psi. Because these values were obtained with different types of apparatus at widely different times, there may be inconsistencies among them. By refining measurement techniques, Bureau scientists will attempt to improve the accuracy of pressure values at transition points so that they can be used in pressure calibrations.

Thermoelasticity

The high temperatures in the engines of modern aircraft have created a need for metal springs that maintain stable deflection characteristics over a wide range of environmental conditions. However, to design alloys for these springs, basic data are needed on the elastic constants of spring materials. Two different techniques are in use at the National Bureau of Standards in an effort to gather such data—one uses a torsion pendulum and the other, sonic vibrations.

The pendulum equipment includes an oven, photoelectric cell and lamp, timer, counter, and electronic temperature recorder. A wire specimen is suspended from a chuck on the lower end of a vertical steel rod with its lower end inside the oven. Another chuck, firmly fixed to a brass disk, grips the lower end of the specimen. When a small amount of twist is applied to the upper portion of the steel rod, the pendulum oscillates about the axis of the specimen.

The photoelectric cell and lamp, outside the oven, are aligned with two holes in the oven wall. Once in each half cycle of oscillation, light from the lamp strikes a small mirror attached to the pendulum assembly, and is reflected back to the cell. The cell, thus energized, operates the counter and timer until a predetermined number of oscillations is registered. The shear modulus of the wire is then computed from the resonant frequency derived for the specimen and the dimensions and masses of the pendulum assembly. The frequency range of this test is from a fraction of a cycle to 10 cps. Test temperatures up to 525 F are shown on the temperature recorder.

In the sonic vibration method, a bar specimen is suspended from an electromagnetic driver by two asbestos strings and enclosed in a furnace which operates at temperatures up to 1000 F. The specimen is excited to its resonant frequency by the driver and a variable audio oscillator. A crystal pickup detects the vibrations, which are displayed on a cathode-ray oscilloscope. The frequency of the oscillator is then adjusted to the frequency of the specimen, indicated by the amplitude of the oscilloscope trace, and this adjusted frequency is measured with an electronic events-per-unit-time counter.

The specimen can be made to vibrate either in tension or torsion, so that both Young's modulus and the shear modulus may be determined without changing the mode of suspension.

Wanted: Tougher Books

EVER worry about the paper in a book, how it grows yellowed, dog-eared, tattered, finally becomes little better than dust? Well, the Council of Library Resources, Inc., has been worrying, but thinks now it may have found a paper with potentially useful life of 300 years. If so, a book like "Return to Peyton Place" would be able to outlast practically all present day card-holders in American libraries—or maybe that wouldn't be a good idea after all.

Under a grant from the council, the Virginia State Library at Richmond studied 500 typical nonfiction books, to find out just how strong present-day book paper really is. Books published between 1900 and 1939 showed 39 per cent had "very weak" paper, 49 per cent were of "low strength," 9 per cent had "medium strength," and only 1 per cent received the accolade of "high strength." And 57 per cent of those published between 1940 to 1959 were in the "low strength" category.

While the council still is conducting experiments to find a modern, tough book paper, it issued its report ("Deterioration of Book Stock—Causes and Remedies") on the one that allegedly might last 300 years. The ingredients include a something called Aquapel, a sizing for the surface that was thought up specially by the Hercules Powder Co. If you think a powder company an odd bedfellow for books, remember there was a man named Nobel who had something to do with dynamite.

New York Times Book Review
March 20, 1960

Measurements of Human Reaction to Hardness of Floor Covering

By R. SCHJÖDT

PEOPLE REACT to the hardness of a floor upon which they walk. The difference between a concrete or terrazzo floor, and a rubber or cork tile floor covering can be clearly felt. Those people, such as nurses and shop attendants, who are required to walk or stand much during their working hours, are quick to complain if the flooring is too hard. The hardness, or conversely, cushioning effect, of floors is an important part of our housing standards.

Earlier Work

When it comes to measuring the hardness of different floor surfaces and thus expressing in numbers the feeling mentioned above, difficulties appear. In spite of many attempts it has not been possible, as far as the author knows, to register in any measuring apparatus the difference felt between hard and cushioned floor surfaces. For instance, Holden and Muncey (1)[1] have measured the pressure on the foot by means of condensers placed between the foot and shoe. The electric capacity changes due to pressure were recorded. The results, however, show no variations from recordings made for concrete, timber, or cork tile floor. The conclusion reached in this and other tests is that variations due to changes in the floor surface are almost nonexistent.

Many writers on the subject of floor coverings have concluded that the feeling of relative softness or hardness of the coverings is an illusion resulting from the heat-insulation capacity of the floors (2). It is frequently maintained that it is wrong to speak of "soft" and "hard" floors; one ought to speak rather of "warm" and "cold" floors. The reason given is that the deformation of the shoes and of the flesh layer between the skin and the bones of the foot is so much greater than that of the floor covering, that the latter is of no importance.

As a result, any discussion of the softness—the degree of agreeable or nonagreeable walking on different flooring materials—is left out of the text books, and no attempt is made to decide upon specifications for softness which floor coverings in different rooms ought to satisfy.

The author does not agree with the point of view given above. When stepping from a hard to a soft floor, one feels the difference before any heat transport could possibly have made itself felt. But this opinion, to have any value, has to be backed by measurements that register the differences between floor coverings.

Possible Methods

It is evidently useless to repeat the measurements of the pressure on the foot. The feelings of hardness and tiredness occur in the muscles and in the nervous system, however, and therefore it appears natural to see whether it is possible to measure directly the work done by the muscles during walking.

Various methods of testing seem possible, apart from recording the pressure. Schwartz, Heath, Miziek, and Wright (3, 4), have measured the time spent on the heel, fifth metatarsal, and great toe of each foot. However, it does not seem likely that this will lead any further than the pressure measurements.

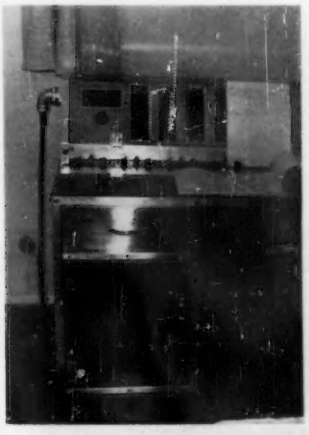


Fig. 1.—Showing (*left*) test subject with electrodes attached, and (*right*) electromyograph recorder.

The wires from the electrodes run to a cross-coupling panel, carried on the subject's back, and this is connected to the recorder. Concrete slabs with various floor coverings can be seen.

R. SCHJÖDT received his doctor's degree in Civil Engineering in 1934. He has worked twelve years in Brazil as an engineer and a consulting engineer on bridges, dams, and structural design. He was in charge of civil engineering on the Norwegian atomic reactor, and since 1950, has been research engineer at the Norwegian Building Research Inst. in charge of research and control of floors and floor coverings.

NOTE—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author or authors. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

Electromyography, the recording of electric muscle-action potentials, has been extensively used in the last decade for analysis of muscle coordination. The potential changes travel along the muscle fibers, and cause activation of the contractible substance. The electric potentials in the muscles are recorded, through the electrodes fastened to the skin, by cathode-tube oscillographs. This method of recording the work of the muscles seems to have been used first by Erlanger and Gasser (5), and Lundervold (6) for measuring the muscular energy in typewriting.

The author awakened the interest of Lundervold in the present problem, and a collaboration was initiated, Lundervold seeing the problem from the physiological angle, and the author from the technical.

Fig. 2(*a*) and 2(*b*), and it is still clearer where the person has walked from concrete to soft floor coverings, and the reverse. But this qualitative result is evidently not sufficient. It is still necessary to express the results in numbers that show clearly the degrees of hardness registered for various materials.

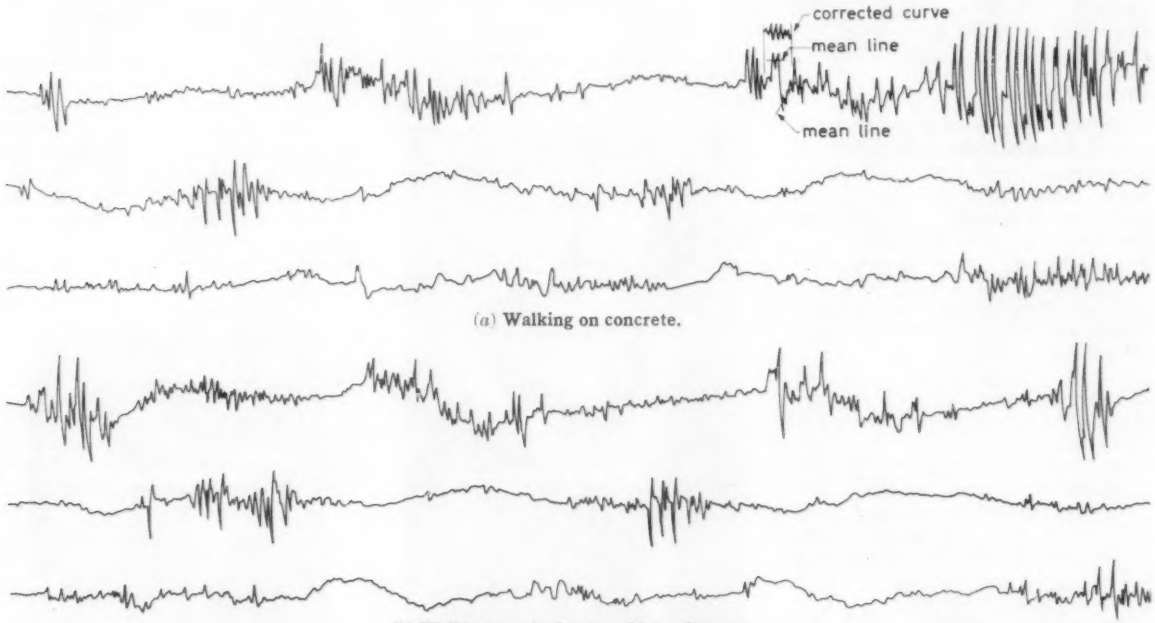
Discussion of Results

Lundervold has shown that tiredness results when two antagonist muscles are working simultaneously. It was therefore decided to register the lengths of time when two such muscles were working together. When using the curves shown in Fig. 2, only the periods were added where the muscles of the first and second electrode, and the second and third, were working together.

Only deviations from the mean line are recorded; the "long wavelength" oscillations seen on the curves are not considered. The recorders also have a tendency to continue a sideway movement once they are started, and thus break the mean line. This is illustrated in part of the first curve in Fig. 2 (*a*) where the mean line is indicated, and the corrected curve is drawn above.

Furthermore, persons performing the test do not walk with exactly the same speed every time. To make the results more comparable, characteristic points on the curves were found, and the curves were redrawn so that the distances between these points were always the same.

Part of the first two curves in Fig. 2 are redrawn in Fig. 3 in the way described above. To determine the degree of tiring muscular activity, the



(*a*) **Walking on concrete.**

(*b*) **Walking on vinyl covered by soft carpet.**

Fig. 2.—Electromyograph curves for muscle action in left leg (Pre-tibial group, Calf group, and Quadriceps group).

The recorders have a tendency to continue a sideway movement once this has started, and thus break the mean line. In Fig. 2(*a*) is shown how this is corrected when the areas of activity are calculated.

The "long wavelength" oscillations seen on the diagrams have no significance.

Experimental Methods

The tests consisted in having various persons walk on different floor coverings, and recording the work performed by the muscles (Fig. 1). The electromyograph was an eight channel brass amplifier and recorder, with a sensibility of 500 μv per in. The results are as shown in Fig. 2.

The question whether there was any real difference registered in the muscle work when walking on different flooring materials was decided in the affirmative. (See Fig. 2). The differences are evident if one compares, for instance, the right-hand part of the first curve in

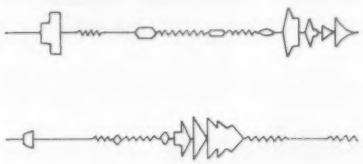


Fig. 3.—Extract from the first 4 in. of the first two curves of Fig. 2.

In calculating the areas of muscular activity, only the parts where both muscles are active simultaneously are counted.

Thus, for instance, the areas of activity appearing in the upper curve between 1 and 2 and between 8 and 9 cm are not counted, because the other muscle is inactive on these stretches.

areas of activity are shown in Fig. 3. Two muscles are always counted together, and only those parts are counted where both muscles are in activity. The stretches drawn as a wavy line (compare with Fig. 2 for their characteristics) are counted as active, but the area is zero. In other words, the activity of the other muscle is counted over these stretches.

The curves obtained have been analysed in this way. The results vary a good deal from individual to individual, and for the same individual from covering to covering. But the correlation of results for the different

TABLE I.—TEST RESULTS FOR SUBJECTS WALKING ON DIFFERENT FLOOR SURFACES.[a]

Subject	Concrete				0.05-in. Sheet Rubber plus 0.15-in. Foam Rubber				Rubber as Before Plus Carpet			
	With Shoes		Barefoot		With Shoes		Barefoot		With Shoes		Barefoot	
	Calculated	Average	Calculated	Average	Calculated	Average	Calculated	Average	Calculated	Average	Calculated	Average
No. 1	35	58	...	...	38	42	...	...	27	20	...	..
	80	...	...	...	42	...	...	...	13	...	...	..
	...	...	...	...	47	...	...	...	...	...	...	..
No. 2	171	173	253	222	123	117	151	149	74	82	...	..
	174	...	191	...	110	...	147	...	96	...	...	..
No. 3	124	138	151	140	...	...	...	...	100	103	98	91
	151	...	140	...	...	...	...	...	105	...	84	..
	...	...	129	...	...	...	...	...	...	...	...	..
No. 4	104	85	56	60	50	64	50	53	67	48	40	45
	69	...	48	...	77	...	55	...	31	...	52	..
	84	...	56	...	...	...	54	...	45	...	52	..
	81	...	54	...	...	...	...	...	...	...	34	..
	...	...	84	...	...	...	...	...	...	...	47	..
No. 5	85	82	84	99	46	61	81	58	50	47	101	95
	71	...	105	...	70	...	29	...	53	...	82	..
	83	...	161	...	67	...	65	...	38	...	102	..
	88	...	91	...	...	...	...	...	...	...	...	..
Average		107		130		71		87		64		77

[a] Areas of activity in square centimeters, for pre-tibial group plus calf group. One square centimeter represents 33.3 μv-sec.

TABLE II.—TEST RESULTS AS IN TABLE I BUT FOR CALF GROUP PLUS QUADRICEPS GROUP.[a]

Subject	Concrete				0.05-in. Sheet Rubber plus 0.15-in. Foam Rubber				Rubber as Before Plus Carpet			
	With Shoes		Barefoot		With Shoes		Barefoot		With Shoes		Barefoot	
	Calculated	Average	Calculated	Average	Calculated	Average	Calculated	Average	Calculated	Average	Calculated	Average
No. 1	37	39	...	...	21	30	..	..	24	22	...	..
	41	...	...	...	16	...	..	..	20	..	...	..
	...	...	...	...	19	...	..	..	...	..	...	..
No. 2	80	75	149	148	54	47	94	92	20	24	...	..
	69	...	147	...	40	...	89	..	8	..	...	..
No. 3	17	12	32	21	...	...	..	..	10	7	6	9
	7	...	20	...	...	...	..	..	3	..	12	..
	...	...	12	...	...	...	..	..	...	..	...	..
No. 4	193	155	96	111	90	114	80	87	108	91	101	97
	130	...	118	...	137	...	85	..	77	..	97	..
	165	...	111	...	...	...	96	..	86	..	100	..
	135	...	119	...	...	...	..	..	...	..	91	..
No. 5	79	38	24	39	10	12	6	14	34	25	32	27
	30	...	15	...	18	...	19	..	29	..	18	..
	31	...	72	...	9	...	17	..	13	..	30	..
	12	...	44	...	...	...	..	..	...	..	...	..
Average		64		80		40		64		34		44

[a] Areas of activity in square centimeters, for calf group plus quadriceps group. One square centimeter represents 33.3 μv-sec.

TABLE III.—AVERAGE VALUES OF AREAS OF ACTIVITY FOR MUSCLES IN PRE-TIBIAL GROUP PLUS CALF GROUP. TEST PERSONS WERE USING SHOES. FOR COMPARISON, VALUES OF SHORE AND INDENTATION TESTS.

Material	Areas of Activity, sq cm	Shore Hardness "Durometer" Type "D"	Indentation Tests
Concrete	107	100	..
Vinyl asbestos tile, 0.08 in.			
On concrete	81	77	9.5[a]
On wood	46	77	4.3
Linoleum, 0.10 in. on concrete	70	65	6.5[b]
0.05-in. sheet rubber on 0.15-in. foam rubber on concrete	71	19	0.6
Same, with 1/8-in. woolen carpet, on concrete	64	...	...
Cork tiles, 5/16 in., on concrete	59	38	3.8
Sheet vinyl 1/32 in., felt base 1/16 in., on concrete	48	25	2.4
Norway spruce	57	40–50	2.6

[a] For test floor. Indentation tests for different vinyl floors give values from 2.9 to 12.0.
[b] For test floor. Indentation tests for different linoleum floors give values from 2.5 to 6.6.

floor coverings was good. Results are shown in Tables I and II.

The kind of shoes used, thickness of soles, height of heels are all important. Therefore experiments were carried out with the subjects walking barefoot and in high-heeled shoes. The results with the high-heeled shoes were in good agreement as far as muscle work was concerned, but showed that other muscles were used. Lundervold will publish an account in which this will be discussed.

The results for subjects walking barefoot are also shown in the tables. The agreement with the tests with shoes is good. The work of the muscles in Table I increases about 20 per cent when walking barefoot; for the muscles in Table II the increase is about 40 per cent.

The work in muscles higher up in the body (hamstrings group, erector spinae, and gluteus maximus) was in good agreement with the results shown.

The results grouped according to floor materials are shown in Table III, These electromyograph results are from the calf group and pre-tibial muscle group with the subject wearing shoes. Any muscles other than those registered, could have been used without changing the relationships. The difference in registered muscle work is very pronounced, and agrees very well with the feeling of "cushioned" effect of the floor coverings.

Electromyograph tests cannot be made easily every time it is desired to examine the qualities of a floor covering. The importance of the test lies primarily in establishing the actual reality behind the feeling of hard or soft floors, and in giving a basis for comparison.

TABLE IV.—FRICTION COEFFICIENTS OF VARIOUS FLOORING MATERIALS

Material	Leather Sole				Rubber Sole			
	Dry		Wet		Dry		Wet	
	Static	Kinetic	Static	Kinetic	Static	Kinetic	Static	Kinetic
Concrete	0.54	0.45	..	..	0.74	0.71	..	..
Vinyl tile	0.46	0.39	0.30	0.11	0.58	0.54	0.63	0.47
Rubber	0.45	0.63	0.43	0.27	0.44	0.63	0.87	0.50
Sheet vinyl	0.43	0.39	0.78	0.29	0.48	0.67	0.82	0.61
Cork tiles	0.42	0.34	0.78	0.55	0.53	0.50	1.00	0.98
Linoleum	0.27	0.25	..	..	0.42	0.36	..	..
Norway spruce, varnished	0.31	0.25	..	..	0.50	0.40	..	..
Terrazzo	0.25	0.22	..	..	0.38	0.34	..	..
Limestone, honed	0.27	0.21	..	..	0.38	0.27	..	..
With fine sand on the soles:								
Terrazzo	0.26	0.26	..	..	0.31	0.29	..	..
Limestone, honed	0.10	0.10	..	..	0.15	0.13	..	..

Practical Tests for Floor Surfaces

For a more practical way of testing the floor hardness, results of Shore tests and indentation tests are shown in Table III. The Shore test consists of introducing a spike in the material, and registering the resistance to penetration. The indentation test is made with an indentation tester (**7**, **8**). The indenting tool consists of a flat-ended cylindrical steel rod 1/4-in. in diameter, carrying a load of 29 lb. The values given in Table III are the inverse of the indentation in millimeters after 30 sec.

The Shore tests give a useful idea of the cushioning effect of a flooring material, rubber excepted. But they do not give any information about the floor as a whole, as they indicate only the characteristics of the surface material. Comparison between vinyl tile on concrete and on wood illustrates this.

In Table III the agreement between electromyograph and indentation tests is excellent, with the exception of the results for rubber. The Shore and indentation tests give very low, that is, "good" results for rubber, whereas the electromyograph places rubber far higher on the scale. Again, this agrees with "feeling." Rubber feels soft, but in spite of this, walking on rubber is not as agreeable as might be expected.

Friction Coefficients for Floors

To clear up this point, if possible, the friction coefficients of the materials were measured (**9**). Table IV gives the results for tests made by pulling a weighted sole along the floor (**10**). In some cases special test floors (Fig. 1) could be tilted so that the friction angle could also be measured directly.

The last two tests were included to establish the minimum safe value of the friction coefficient. In the lobby of a research institute, it was found necessary to put up warnings, "Take care, the floor is slippery." When this floor (limestone) was tested in the usual way, it gave practically the same results as terrazzo. However, when the tests were repeated with fine sand on the soles, this did not make much difference for the terrazzo, but lowered the friction coefficient to less than half of its former value for the limestone.

The results indicate that the friction coefficient for a floor material, tested as above for kinetic friction, ought to be not less than 0.20, and not more than 0.40, for leather soles.

It will be seen that rubber behaves differently from the other materials. It is well known that the static friction coefficient is higher for other materials but for rubber the kinetic coefficient is higher. The same result is found for sheet plastic with rubber sole, probably because the sole has decided the issue here. It is thus easy to explain why the electromyograph places rubber in a more disadvantageous situation than the Shore and indentation tests. The foot slides along the floor before being lifted. Then the kinetic friction coefficient comes into play, giving, for rubber, an increased resistance to motion, and causing increased muscle work.

Hardness Scale for Floors

It is tempting, on the basis of what was found above, to propose a hardness scale for floor surfaces, similar to the Mohs hardness scale. An approximate scale is given in Table V.

TABLE V.—HARDNESS SCALE FOR FLOOR SURFACES.

Relative Hardness	Material
10	Concrete, terrazzo, stone
7	Vinyl asbestos tiles
6	Linoleum, soft rubber
5	Cork tiles, soft wood, cork linoleum, high-grade vinyl
4	Sheet vinyl on felt base

Even though this Table V is far from exact, it gives the relative hardness of the flooring materials, and also a basis for indicating in building specifications the flooring wanted.

Which floor will be felt to be satisfactory in the different rooms and corridors depends very much on the standard of comfort in the locality. The author has come across a typical example of this. The small Norwegian town, Steinkjer, was destroyed by fire during the war. Like all Norwegian small towns, it was formerly built of wood, but was rebuilt in concrete. During the first two years after reconstruction, nearly the entire population complained that their feet hurt. Later the complaints died down. The town had become accustomed to a lower standard of comfort.

Summary

Tests were carried out to see what differences can be recorded between the hardnesses of different flooring materials felt when walking. Since direct pressure recording by various methods has given no results, the author used the electromyograph tests. A clear difference in the reactions was found—in agreement with "feeling," and with Shore tests and indentation tests. The importance of friction in the effect of softness of floor surfaces is considered, and a hardness scale is proposed.

References

(1) T. S. Holden and R. W. Muncey, "Pressure on the Human Foot During Walking," *Australian Journal of Applied Science*, Vol. 3, 1953, pp. 405–417.

(2) W. Schüle, "Wärmetechnische Fragen bei Fussböden und Decken unter besonderer Berücksichtigung der Fusswärme," *Gesundheitsingenieur*, Vol. 78, No. 19–20, pp. 289–295 (1957).

(3) R. P. Schwartz, A. L. Heath, and J. N. Wright, "Electrobasographic Method of Recording Gait," *Archives of Surgery*, Nov., 1933, Vol. 27, pp. 926–934.

(4) R. P. Schwartz, A. L. Heath, W. Miziek, and J. N. Wright, "Kinetics of Human Gait," *The Journal of Bone and Joint Surgery*, Vol. XVI, No. 2, Apr., 1934, pp. 343–350.

(5) J. Erlanger and H. S. Gasser, "Electrical Signs of Nervous Activity," University of Pennsylvania Press Lectures, Vol. 10, p. 222 (1937).

(6) A. J. S. Lundervold, "Electromyographic Investigations of Position and Manner of Working in Typewriting," A. W. Broggers, Oslo (1951).

(7) P. A. Sigler and M. B. Woodward, "Indentation and Recovery of Low-Cost Floor Coverings," Building Materials and Structures, *Report BMS 14*, National Bureau of Standards, Washington, D. C.

(8) P. A. Sigler and M. B. Woodward, "Indentation Characteristics of Floor Coverings," *BMS 73*, National Bureau of Standards, Washington, D. C.

(9) P. A. Sigler, "Relative Slipperiness of Floor and Deck Surfaces," *BMS 100*, National Bureau of Standards, Washington, D. C.

(10) Otto Graf, "Handbuch der Werkstoffprüfung," Vol. III, 2nd Ed., Berlin, Chapter XXII (1957).

The Tensile Properties of Some Engineering Materials at Moderate Rates of Strain*

By ROBERT F. STEIDEL, Jr., and CYRIL E. MAKEROV

THE DYNAMIC strength of materials depends both on the permanent strain to which the material is subjected and the rate at which this strain is applied. For normal engineering materials this strength usually decreases with temperature and increases with strain rate. This research was undertaken to determine more exactly the effect of strain rate on the dynamic strength of certain materials and to extend the strain rate at which the strength had been measured.

The fact that the ultimate strength of certain materials increased with speed of deformation was recognized at a very early date. Most of the early references on the subject include strain rate as an influencing factor on any strength test. Ludwik (1)[1] included the influence of strain rate in his considerations of the resistance of a metal to permanent change in shape. He stated that this resistance increases with permanent strain and with strain rate, and concluded from his tests that the ultimate strength increases as the logarithm of the rate of strain.

Many methods have been used to determine the dynamic strength of materials. Dropping weights, Izod or Charpy pendulum machines, rotary impact machines, and explosive impact testers have all been used for this work. In general, only the explosive impact tester, or bomb tester, can be used for strain rates beyond 1000 in. per in. per sec.

Most of the early work in the dynamic strength of materials was done in Germany. This was comparatively inexact and usually gave only the final strength of the material and final elongation. The actual dynamic stress-strain diagram has been determined only by two recent investigations, that of Nadai and Manjoine (2) and that of Clark (3, 4). Both of these works covered the range of strain rates from 100 to 1000 in. per in. per sec. Nadai and Manjoine used a rotary impact machine and instrumentation yielding a force-elongation diagram on a cathode-ray oscillograph. The relative motion between the heads of the testing machine was used to indicate strain and strain rate. The stress on the specimen was indirectly determined by measuring the load on a load gage. Clark used the same instrumentation but did his work with an Izod pendulum. In general, his strain rates were an order of magnitude less than those achieved by Nadai and Manjoine.

The work in impact research at the Massachusetts Institute of Technology deserves to be mentioned specifically. The explosive impact tester, or bomb tester, was developed by deForest and his associates. Strain rates of 5000 to 10,000 in. per in. per sec are claimed for full-size $\frac{1}{2}$-in. tensile specimens. Both single-ended and double-ended bombs were used. A most extensive account of this work has been given by Shepler (5). This work was accomplished on steel, copper, and aluminum, and a strain rate of 25,000 in. per in. per sec was claimed. Strain rate was based on the nominal rate of strain and not on the true rate of change of true strain. This could have been done if a photographic record of the stretching of the specimen were taken, but only the final elongation in final loading of the specimen was obtained.

This report covers the investigation at the lower strain rates up to approximately 80 in. per in. per sec.

Materials

Materials tested in this test program were cold-rolled steel, six aluminum alloys, six titanium alloys, uranium, and lead. These materials are listed in Table I. Each material was tested at three static strain rates, approximating 10^{-5}, 10^{-4}, and 10^{-2} in. per in. per sec on a standard Baldwin tension testing machine. In addition, each of these materials was tested at a strain rate of approximately 10^{2} in. per in. per sec on a modified Charpy impact testing

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C. E. MAKEROV is a native of Berkeley, Calif., and was graduated from the University of California. He has been with the Lawrence Radiation Laboratory for seven years, and has done impact strength research for the past three years. At present he is a member of the Stress Analysis and Environmental Group, and is a member of the Society for Experimental Stress Analysis and the Institute of Environmental Sciences.

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* This work was performed under auspices of the U. S. Atomic Energy Commission.

[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

TABLE I.—MATERIALS TESTED.

Aluminum 7075-T6	Titanium RS-55	1018 Cold-rolled steel
Aluminum 6061-T6	Titanium RS-70	Uranium D-38
Aluminum 6061-O	Titanium RS-110B	Lead
Aluminum 5456-O	Titanium RS-120A	.....
Aluminum 5154-O	Titanium RS-120AV	.....
Aluminum 5056-O	Titanium RS-130	.....

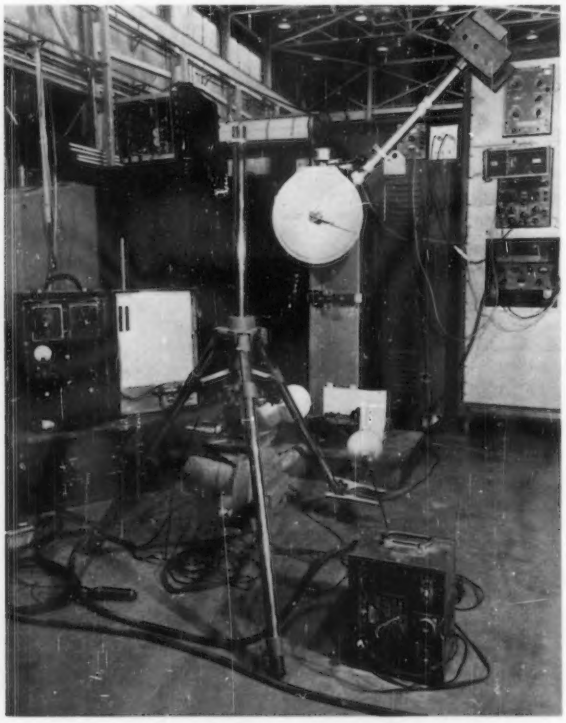


Fig. 1.—General view of the apparatus.

machine. The major portion of this report is concerned with an account of the latter test work.

Instrumentation and Apparatus for Impact Tests

The modifications to the Charpy impact testing machine can be seen in the general view of the apparatus in Fig. 1. In this apparatus the test specimen (Fig. 2) was attached to the pendulum of the impact testing machine. A steel striking disk was placed at the end of the test specimen to provide contact with an anvil. The anvil consisted of two steel upright sections. A detailed view of the specimen at the time of impact is shown in Figs. 3 and 4. A steel load bar, with two SR-4 type A-7 resistance wire strain gages, connected the specimen with the pendulum proper. This load bar is shown in the schematic diagram of the hammer and anvil in Fig. 3. To eliminate the effect of bending, the strain gages were connected in series. To measure the load on the specimen, the strain gages attached to the load bar were connected through a Model BA-12 Ellis Associates bridge amplifier to a Model 304-B Dumont cathode-ray oscilloscope. A trigger located on the face of the impact testing machine made contact with a finger on the hammer arm to start the oscilloscope sweep just prior to impact. A polaroid Land camera was used to record the strain-time pulse on the load gage during impact. A Fastax camera and accessories, Model W-1, with a maximum speed

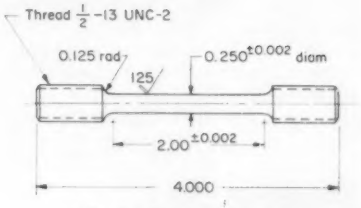


Fig. 2.—Test specimen.

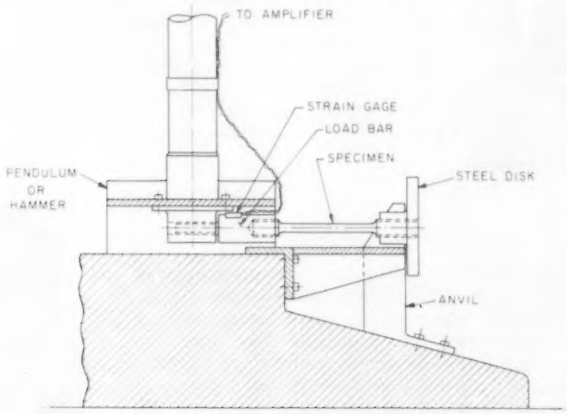


Fig. 3.—Arrangement of pendulum, anvil, and specimen.

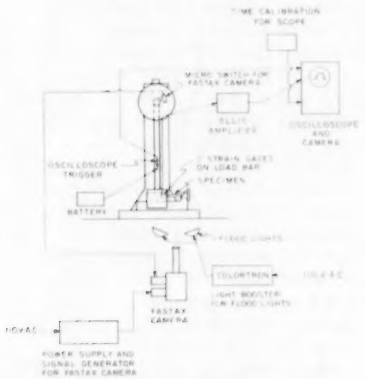


Fig. 4.—Schematic arrangement of apparatus.

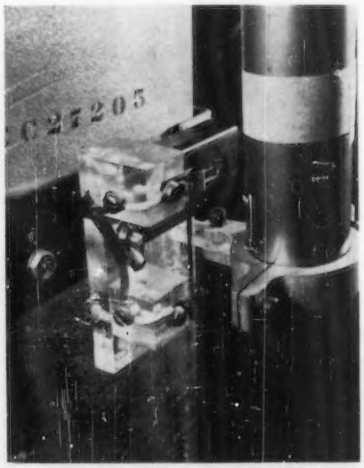


Fig. 5.—Oscilloscope trigger.

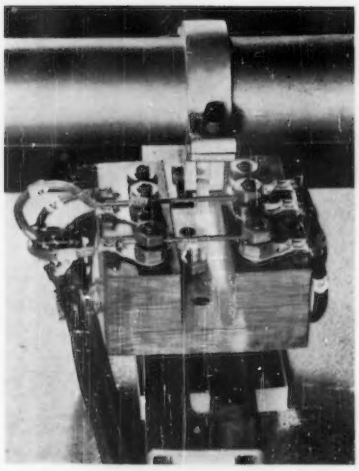


Fig. 6.—Electronic trigger for measuring hammer velocity.

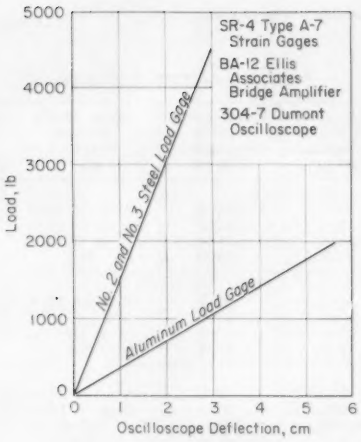


Fig. 7.—Load-bar calibration for impact tests.

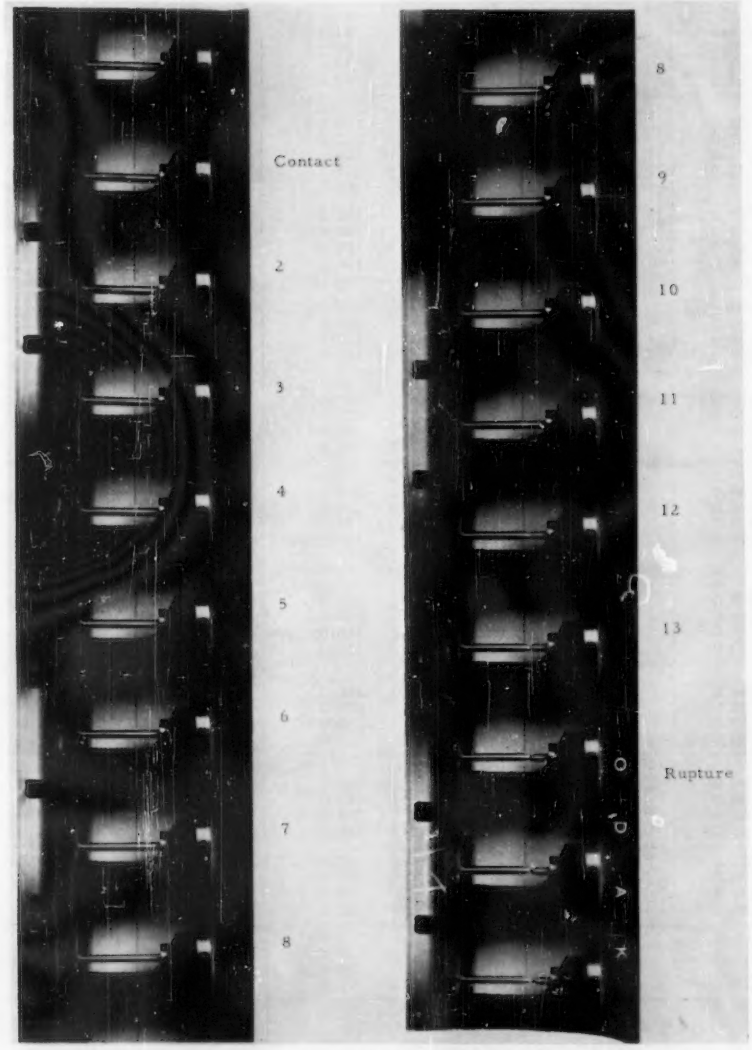


Fig. 8.—Fastax film strip of 1018 cold-rolled steel specimen.

of 7000 frames per sec, was used to record photographically elongation and reduction of area during the impact. Three floodlights were used to illuminate the specimen. White cardboard placed behind the specimen was used for contrast. The camera and its accessories are also shown in the foreground of Fig. 1. The photographic record of the deformation of the test specimen synchronized with the oscilloscope trace of the strain on the load bar permitted an accurate determination of the stress-strain diagram.

The schematic diagram of the impact tester, oscilloscope, Ellis amplifier, Fastax camera, power supplies, and accessories is shown in Fig. 4. The trigger for the oscilloscope is shown in Fig. 5. In operation, the lever on the pendulum arm breaks the carbon pencil lead across which 300 v are applied. This puts a negative pulse on the oscilloscope.

Preparation for Tests

One end of the test specimen was threaded into the load bar attached to the pendulum. The steel striking disk attached to the other end of the specimen was adjusted for contact with the pendulum in the equilibrium position. The oscilloscope trigger was adjusted so that a lever on the hammer arm made contact with the trigger, initiating an impulse causing the sweep of the oscilloscope. This trigger was adjusted to sweep the oscilloscope just prior to the impact of the circular disk and the anvil upright.

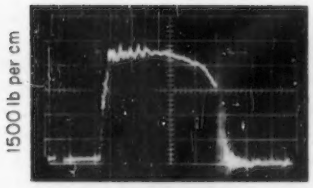
At the start of the test, the hammer, or pendulum, was lifted to its top position. The Fastax camera trigger was adjusted while the hammer was in this upper position so that the camera started at the top of the swing of the hammer. Just before the hammer was released, the floodlights were turned on manually.

Measurements

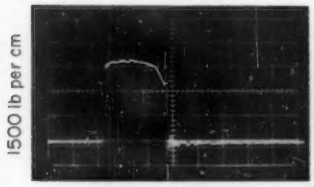
The total energy absorbed in the specimen was determined from the loss in potential energy of the pendulum as read from the scale of the impact tester. The difference between the original and final gage length was measured. The reduced diameter was measured directly from the specimen. The load is interpreted from the oscilloscope trace, and the displacement-time record was taken directly from the Fastax photographs. The framing speed of the camera gives the timing intervals for each particular frame. Although the framing speed is not constant, the speed can be correlated with the known speed of the hammer at impact. The average hammer velocity at rupture was measured with an electronic trigger, using two pencil leads 1 in. apart. (See Fig. 6.) These leads were broken by a small

TABLE II.—TEST RESULTS.

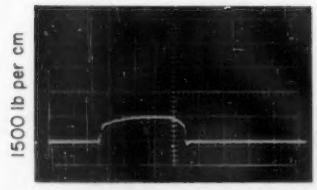
Material and Specimen No.	Nominal Strain Rate, sec^{-1}	Engineering Yield Strength, 1000 psi	Engineering Tensile Strength, 1000 psi	True Strain Rate at Fracture, sec^{-1}	True Fracture Stress, 1000 psi	Elongation at Fracture, per cent	Reduction of Area, per cent
Aluminum alloy 5154-O	4.1×10^{-5}	19.3	35.4	1.9×10^{-4}	90.0	19.7	59
	5.1×10^{-4}	19.5	35.2	1.9×10^{-3}	86.0	24.4	60
(35-5)	5.3×10^{-2}	22.6	34.0	0.25	77.0	23.0	66
(K-1)	40	22.8	35.0	310	58.0	27.0	66
Aluminum alloy 5456-O	3.1×10^{-5}	22.2	48.0	6.2×10^{-5}	69.2	16.9	29
	3.8×10^{-4}	22.6	48.2	5.5×10^{-4}	63.9	18.2	22.7
(35-3)	4.6×10^{-2}	22.0	47.0	0.10	68.8	17.8	36
(I-2)	70	22.5	42.5	220	60.0	21.0	48
Aluminum alloy 6061-O	3.4×10^{-5}	7.7	19.8	1.5×10^{-4}	54.0	23.5	64
	5.6×10^{-4}	9.2	20.2	2.3×10^{-3}	53.0	22.5	62
(35-7)	5.5×10^{-2}	8.6	20.8	0.229	47.7	26.5	67
(L-1)	80	9.0	21.0	310	32.0	33.3	73
Aluminum alloy 6061-T6	1.8×10^{-5}	43.3	48.4	1.2×10^{-4}	87.3	8.0	43
	3.7×10^{-4}	41.8	48.6	2.6×10^{-3}	91.6	8.9	45
(39-7)	5.3×10^{-2}	44.7	49.0	0.30	78.0	12.0	50.5
(J-1)	69	45.0	51.0	365	64.0	12.4	48
Aluminum alloy 7075-O	2.7×10^{-5}	19.0	46.4	5.20×10^{-5}	63.2	15.6	26.5
	5.3×10^{-4}	19.5	45.1	8.50×10^{-4}	58.1	16.0	22.7
(31-5)	6.0×10^{-2}	23.7	45.0	0.100	56.0	19.0	27.5
(A-2)	67	24.5	46.0	130	57.0	18.2	29.5
Aluminum alloy 7075-T6	1.9×10^{-5}	64.0	83.0	5.9×10^{-5}	110.0	10.2	19.5
	3.1×10^{-4}	67.0	84.7	7.1×10^{-4}	116.0	12.9	26
	6.0×10^{-2}	70.0	80.0	0.12	108.0	12.0	25.4
(G-2)	43	75.0	85.0	90	114.0	13.0	22.5
Titanium alloy RS-55	6.2×10^{-5}	41.2	66.8	1.95×10^{-4}	164.0	28.0	58
	5.8×10^{-4}	45.0	65.3	1.7×10^{-3}	160.0	31.5	58
(35-13)	5.4×10^{-2}	60.0	68.0	1.9×10^{-1}	116.0	25.0	59
(N-1)	63	72.0	83.0	260	126.0	20.0	58
Titanium alloy RS-70	4.5×10^{-5}	90.0	106.0	1.4×10^{-4}	218.0	23.1	51.5
	4.1×10^{-4}	98.0	106.0	1.8×10^{-3}	260.0	19.5	57.5
(35-14)	4.7×10^{-2}	100.0	106.0	2.3×10^{-1}	124.0	12.0	44.5
(H-1)	31	120.0	128.0	114	155.0	14.2	41
Titanium alloy RS-110B	2.9×10^{-5}	130.0	146.0	1.0×10^{-4}	265.0	16.4	45.5
	3.3×10^{-4}	126.0	139.0	1.4×10^{-3}	273.0	16.0	48.5
(39-4)	4.9×10^{-2}	139.0	146.0	2.4×10^{-1}	194.0	12.0	44
(O-1)	34	166.0	170.0	200	242.0	10.2	45
Titanium alloy RS-120A	2.0×10^{-5}	139.0	155.0	6.6×10^{-5}	230.0	12.0	33
	3.0×10^{-4}	147.0	157.0	9.5×10^{-4}	232.0	12.4	33
(35-19)	4.7×10^{-2}	150.0	157.0	1.9×10^{-1}	197.0	11.5	38
(P-1)	17	170.0	173.0	74	No break	No break	No break
Titanium alloy RS-120AV	1.9×10^{-5}	128.0	137.0	1.10×10^{-4}	264.0	10.7	47
	1.0×10^{-4}	128.0	135.0	6.36×10^{-4}	233.0	8.4	41
(7-4)	0.8×10^{-2}	132.0	140.0	5.03×10^{-2}	182.0	9.3	43
(W-1)	64	129.0	138.0	350	170.0	8.9	46
Titanium alloy RS-130 (2)	2.2×10^{-5}	146.0	149.0	1.0×10^{-4}	256.0	12.4	43.5
	2.0×10^{-4}	152.0	154.0	9.0×10^{-4}	272.0	13.3	45
(7-5)	0.8×10^{-2}	153.0	157.0	5.3×10^{-2}	223.0	10.2	47
(X-1)	113	149.0	149.0	500	170.0	10.2	45
Cold-rolled steel 1018	2.8×10^{-5}	80.0	93.6	2.3×10^{-4}	133.0	7.6	60
	2.5×10^{-4}	80.0	96.9	1.95×10^{-3}	140.0	7.5	44.5
(39-2)	5.3×10^{-2}	85.0	103.0	0.263	124.0	11.5	44
(M-1)	54	95.0	104.0	243	135.0	14.7	48
Uranium D-38	1.91×10^{-5}	21.0	51.0	5.1×10^{-4}	51.0	3.1	7.9
	1.47×10^{-4}	26.7	55.0	1.5×10^{-3}	57.0	2.2	3.2
(8-1)	0.667×10^{-2}	30.6	50.9	0.88×10^{-2}	53.0	3.0	4.0
(B-3)	67	36.0	60.0	1370	62.0	3.6	11.3
Lead	2.1×10^{-5}	2.5	3.5	5.2×10^{-5}	3.5	14.0	29
	2.8×10^{-4}	2.4	3.7	8.0×10^{-4}	5.2	27.0	53
(8-11)	1.4×10^{-2}	2.8	4.2	0.120	32.6	24.0	87
U(-2)	174	5.5	6.5	454	10.0	31.1	84



10^{-3} sec per cm
Specimen H-1: RS-70 Titanium Alloy



10^{-3} sec per cm
Specimen M-1: SAE 1018 Cold-Rolled Steel



10^{-3} sec per cm
Specimen K-1: 5154-O Aluminum Alloy

Fig. 9.—Samples of load-time oscilloscope records.

plastic finger on the pendulum arm, in the same manner as the oscilloscope trigger. The time interval between the pulses caused by breaking the leads was recorded on the oscilloscope. From this the average velocity of the hammer at impact was found.

The load bar, with attached SR-4 strain gages, was calibrated statically in a standard Baldwin testing machine. The calibration curve for the load bar is shown in Fig. 7.

The true dynamic stress was computed by dividing the load as measured by the oscilloscope record of the strain gages by the true area of the specimen. The nominal dynamic stress was obtained by dividing the load by the nominal area of the specimen. The strain rate for these calculations can be measured two ways. The "nominal" strain rate can be determined from the gage length and the specimen velocity.

$$\dot{\epsilon} = \frac{1}{l_0} \cdot \frac{dl}{dt}$$

where:

l_0 = gage length of specimen, in., and

$\frac{dl}{dt}$ = time rate of change of gage length, in. per sec.

To measure the "true" strain rate for fracture requires the measurement of the change in gage length over a very definite time interval.

$$\dot{\epsilon} = \frac{\ln l_2/l_1}{t_2 - t_1} = \frac{\ln A_1/A_2}{t_2 - t_1} = \frac{2 \ln D_1/D_2}{t_2 - t_1}$$

where:

D = instantaneous diameter, in., and

t = time, sec.

It is possible to get the "true" strain rate of some materials, providing the total elongation of the specimen is sufficient to permit the measurement of diametral changes during the "necking down" phase. This is impossible if the "necking down" phase is absent.

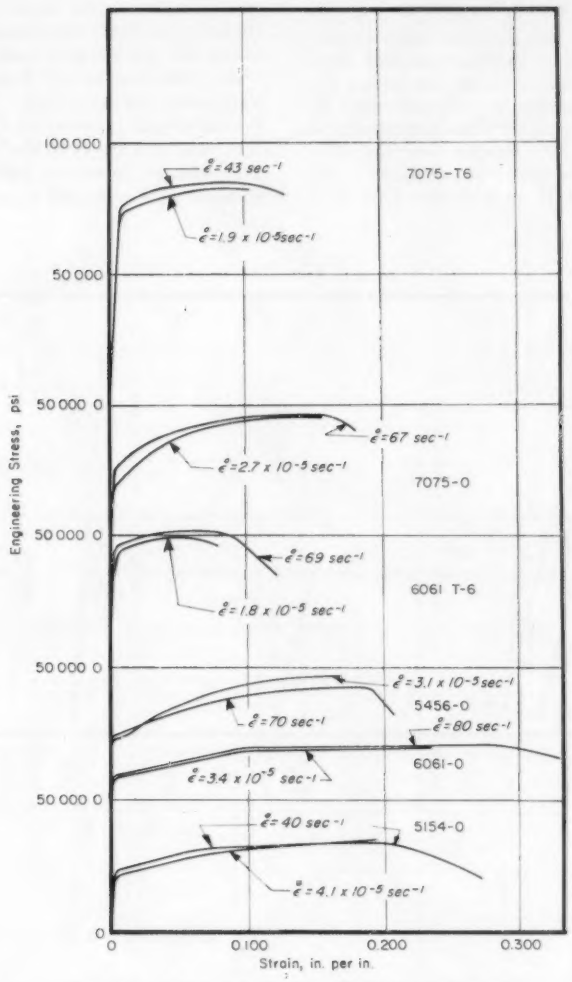


Fig. 10.—Engineering stress-strain, aluminum alloy.

Results

A summary of the results, including the three slower strain rates, is shown in Table II. A photographic record was made of the static tests, as well as the impact testing, to make the results comparable. Photographs of a cold-rolled steel specimen elongating in the impact test are shown in Fig. 8. Rupture occurs in frame 14, approximately 2.2 millisec after the initial contact with the anvil. Oscilloscope photographs of the load-time curves on the load bar for that specimen and two others are shown in Fig. 9. Two, three, or four specimens were tested for each material at each strain rate. The plotted results of yield strength *versus* strain rate for all specimens are shown in Fig. 12. Figures 10 and 11 show typical stress-strain diagrams for static and dynamic loading at the indicated strain rates for the various materials. Only the very slowest of the static test results are plotted. The more rapid of the static tests do not yield results which differ materially and, hence, are merely summarized in Table II.

The plotted results of elongation at fracture *versus* strain rate are shown in Fig. 13. The true stress at fracture and reduction of area at fracture *versus* the true strain rate at fracture are shown in Figs. 14 and 15.

Discussion and Conclusions

As expected, all of the materials show an increase in yield strength with strain rate. These increases vary from a negligible increase in strength over the static strength for 5456-O aluminum to a 72.9 per cent increase over the static strength for 1018 cold-rolled steel. It is interesting to note further that while the aluminum and steel specimens showed a simultaneous increase in elongation for the dynamic case over the static, titanium showed a decrease in elongation with strain rate. This verifies the results reported by Catlin and Wentz (**7**) in a report to the Wright Air Development Center on titanium base material and two recent reports on tensile properties of metals at high strain rates by Austin and Steidel (**8, 9**).

The true stress at fracture for steel and aluminum increases with strain rate. Titanium and titanium alloy evidences some loss in ductility with an increase in strain rate. Consequently, there is a corresponding decrease in true strain at fracture for titanium.

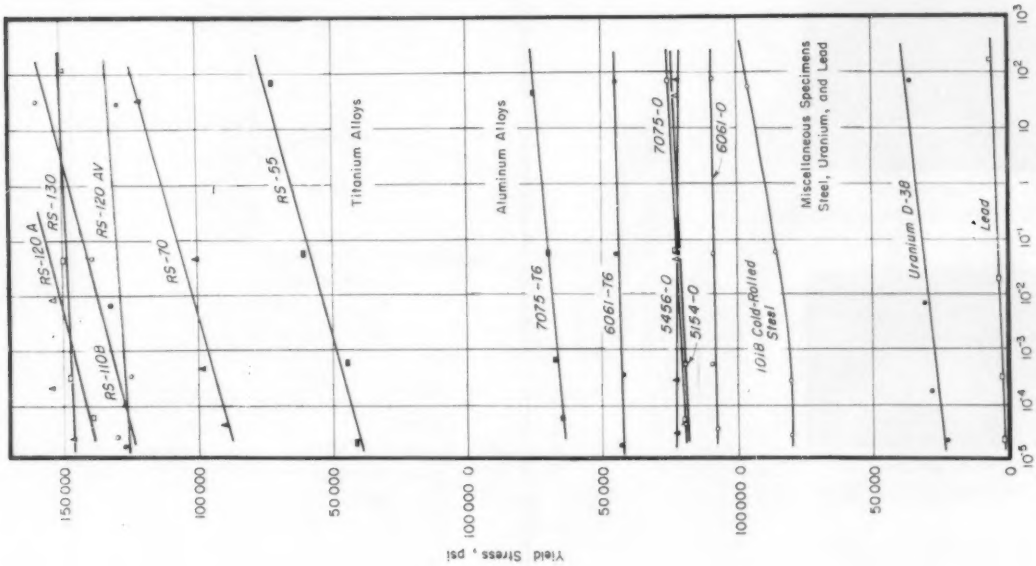


Fig. 12.—Yield stress versus strain rate at room temperature.

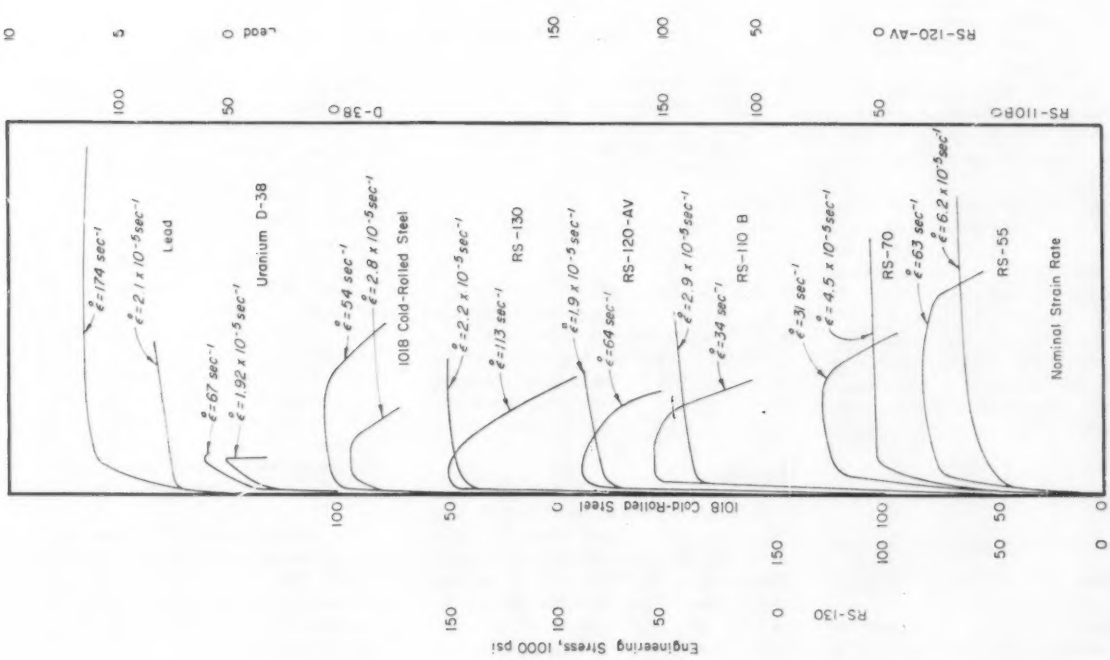


Fig. 11.—Engineering stress-strain, titanium alloy, and miscellaneous specimens.

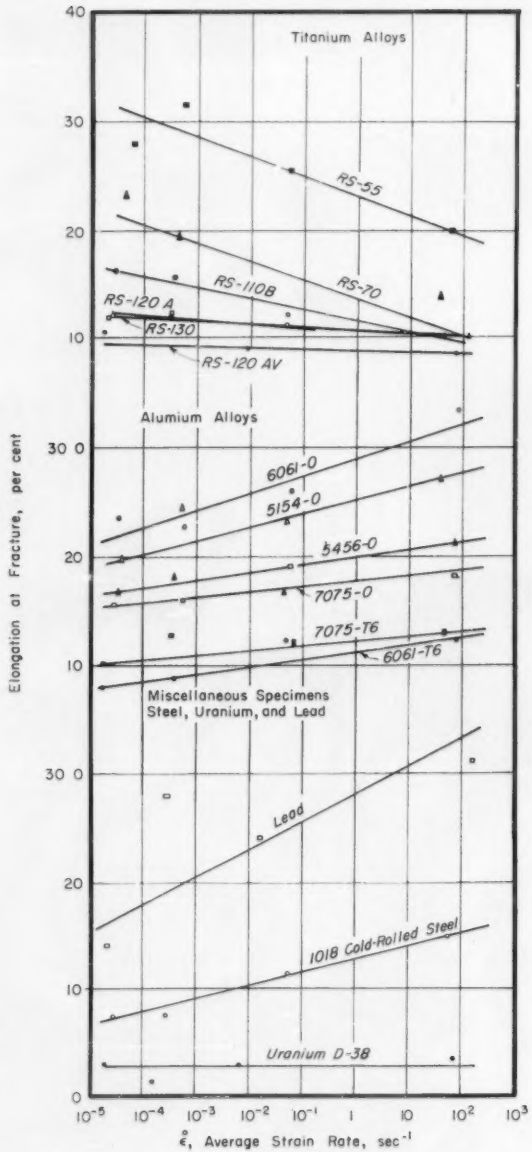


Fig. 13.—Elongation at fracture *versus* average strain rate.

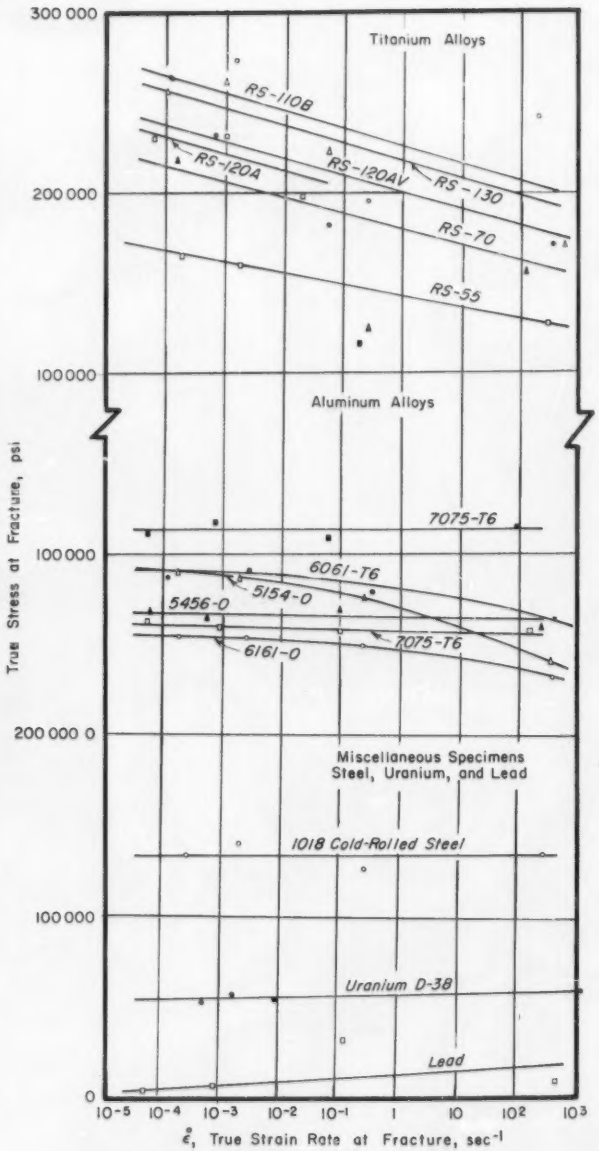


Fig. 14.—True fracture stress *versus* true strain rate.

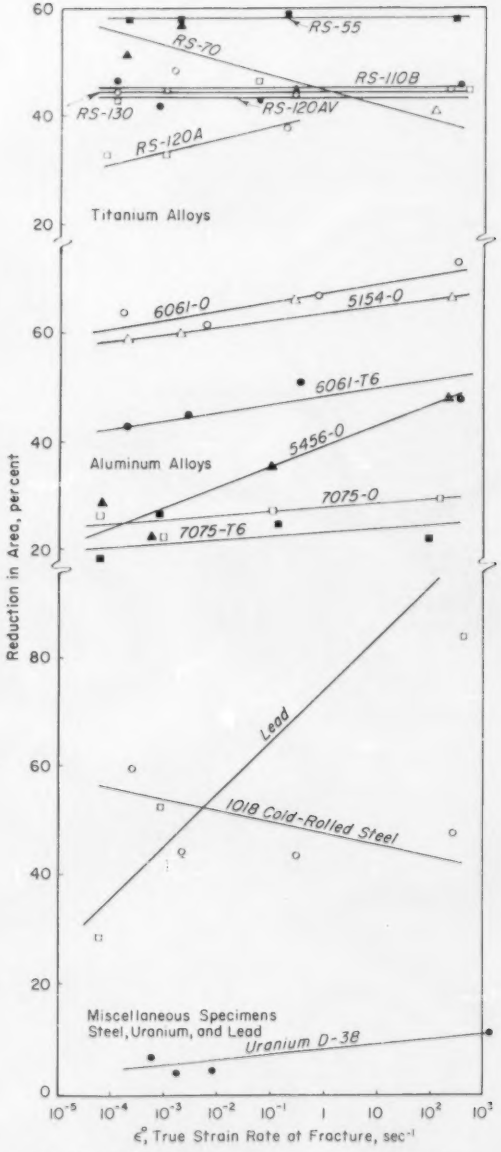


Fig. 15.—Reduction in area *versus* true strain rate.

REFERENCES

(1) P. Ludwik, "Elemente der Technologischer Mechanik," pp. 44–47, Julius Springer, Berlin (1909); also, *Physikalische Zeitschrift*, Vol. 10, No. 12, p. 411, 1909.

(2) M. J. Manjoine and A. Nadai, "High-Speed Tension Tests at Elevated Temperatures," *Proceedings* Am. Soc. Testing Mats., Vol. 40, p. 822 (1940); also, *Transactions* ASME *Journal Appl. Mechanics*, June, 1941, p. A77.

(3) D. S. Clark and G. Datwyler, "Stress Relations Under Tension Impact Loading," *Proceedings* Am. Soc. Testing Mats., Vol. 38, Part II, pp. 98–111 (1938).

(4) D. S. Clark, "The Influence of Impact Velocity on the Tensile Characteristics of Some Aircraft Metals and Alloys," *NACA Technical Note 868*, National Advisory Committee for Aeronautics Oct. 1942.

(5) P. R. Shepler, "Impact Research," Sc.D. Thesis submitted to Mechanical Engineering Dept., MIT, Sept. 27, 1943.

(6) P. W. Bridgman, "The Shape of the Neck and the Fracture of Tension Specimens," Watertown Arsenal Laboratory, *Experimental Report No. WAL 111/7–4*, Jan. 1944.

(7) J. P. Catlin and W. W. Wentz, "Effect of Strain Rate on the Mechanical Properties of Titanium Base Materials," WADC *Technical Report 53–71*, Part 2, Wright Air Development Center, Feb. 1955.

(8) A. L. Austin and R. F. Steidel, Jr., "A Method for Determining the Tensile Properties of Metals at High Rates of Strain," University of California Institute of Engineering Research, *Series 73308-UCX 2185*, Oct., 1958; also, *Proceedings* Society for Experimental Stress Analysis, Vol. XVII, No. 1, pp. 97–115.

(9) A. L. Austin and R. F. Steidel, Jr., "The Tensile Properties of Some Engineering Materials at High Rates of Strain," University of California Lawrence Radiation Laboratory, *Report No. UCRL-5343*, Aug. 1958; also, *Proceedings*, Am. Soc. Testing Mats., Vol. 59 (1959).

Creep Characteristics of Compression-Molded Polyethylene

By G. R. GOHN and J. D. CUMMINGS

Extension-time curves are presented which show the creep characteristics of compression-molded polyethylene compounds at various stresses ranging from 50 to 800 psi for continuous loading periods of 95,000 hr. Comparative curves on the current product are also shown for a period of 8000 hr. These data supplement creep curves on two of the compounds previously presented in 1949 by the authors after a loading period of only 11,600 hr. The data show that times in excess of 40,000 hr are required to establish constant creep rates at all but the lowest test stresses. Hence, it logically follows that equations used for calculating long-time creep from tests of short duration (1000 to 10,000 hr) will give erroneous results if one of the parameters is a constant creep rate as determined from the short-time test.

In 1949, the authors (1)[1] presented a series of extension-time (creep) curves covering the behavior of compression-molded polyethylene compounds having a density of 0.92 g per cu cm when subjected to continuous tensile stresses for periods of approximately 12,000 hr. These tests have since been discontinued after 95,000 hr (11 yr).

After the first creep studies were begun, an investigation of the creep characteristics of polyethylene of higher molecular weight was undertaken. These tests, too, have now been discontinued, and data covering a period of 70,000 hr (8 yr) of continuous loading are available for comparison with data on material of lower molecular weight. Finally, a third series of tests was started in 1958 on high-molecular-weight polyethylene of current manufacture. Data on the latter, after a period of 8000 hr (approximately 1 yr), of continuous loading are also available and may be compared with the test results on the product of earlier manufacture.

Materials Investigated

Materials common to this and the earlier paper are carbon-pigmented

NOTE—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author or authors. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

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JAMES D. CUMMINGS is a member of the Technical Staff of the Bell Telephone Laboratories and received his M.E. degree from the Stevens Institute of Technology. He has been engaged in the evaluation of insulating materials and in consultation regarding their application in communication apparatus. Recently he has also been connected with studies of the flow properties of the polyolefins.

sheets designated lot B from compound prepared by supplier M and lot C from supplier N. These polyethylenes had melt indices of approximately 2.0 g per 10 min when recently determined in accordance with ASTM Method D 1238.[2] The materials in the 70,000-hr test had melt indices of approximately 0.30 and 0.60 g per 10 min, respectively, and those in the 8000-hr tests had melt indices of approximately 0.30 g per 10 min. All of the basic materials were from the same two suppliers and were molded at the Bell Telephone Laboratories into 10 by 10 by 0.125-in. (nominal) sheets. A more complete description is given in Table I.

[2] ASTM Method of Test for Measuring Flow Rates of Thermoplastics by Extrusion Plastometer (Tentative), 1958 Book of ASTM Standards, Part 9, p. 398.

Methods of Test and Test Data

The methods of test used in these studies have been described in the previous paper (1). All specimens had a 3-in. gage length and the test measurements are precise to ±0.07 per cent.

The creep data are presented in the form of extension-time curves in Figs. 1 through 6. In the earlier tests, the plotted points represent tests on only one to three specimens; in the tests on the recent product, they represent

TABLE I.—MATERIALS INVESTIGATED.

Lot	B	C	D	E	F	G
Supplier	M	N	M	N	M	N
Data shown in Fig.	1	2	3	4	5	6
Nominal thickness of sheet, in.	0.125	0.125	0.125	0.125	0.125	0.125
Year molded[a]	1947	1947	1950	1950	1958	1958
Composition (nominal)						
Polyethylene, per cent	98.8	98.8	97.9	97.9	97.3	97.3
Carbon black, per cent	1.0	1.0	2.0	2.0	2.6	2.6
Antioxidant, per cent	0.2	0.2	0.1	0.1	0.1	0.1
Melt index, g per 10 min	1.7	2.2	0.60	0.30	0.25	0.33

[a] All lots molded by Bell Telephone Laboratories.

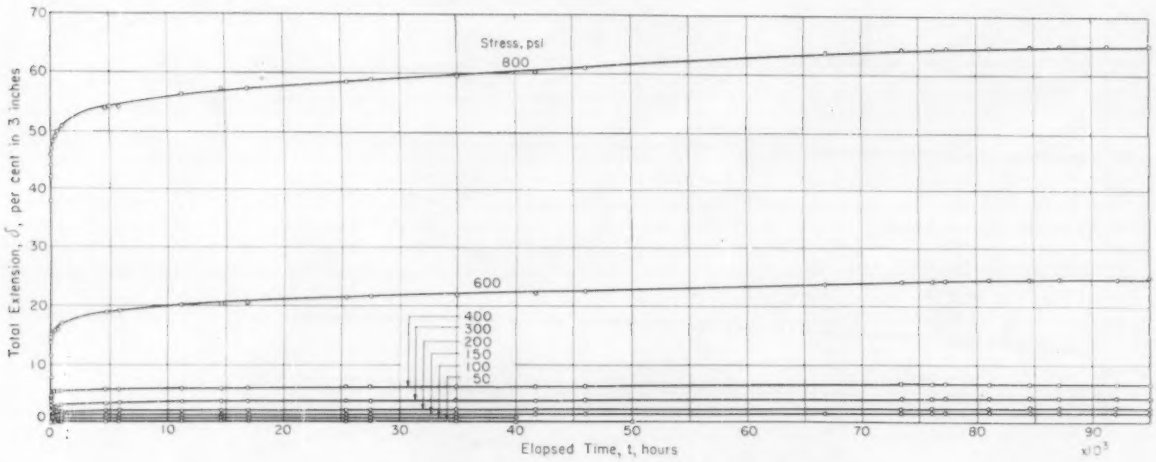

Fig. 1.—Tensile creep of compression-molded polyethylene sheet.
Molded by BTL from lot B raw material, supplier M, tested at 85 F, nominal thickness 0.125 in., melt index 1.7 g per 10 min.

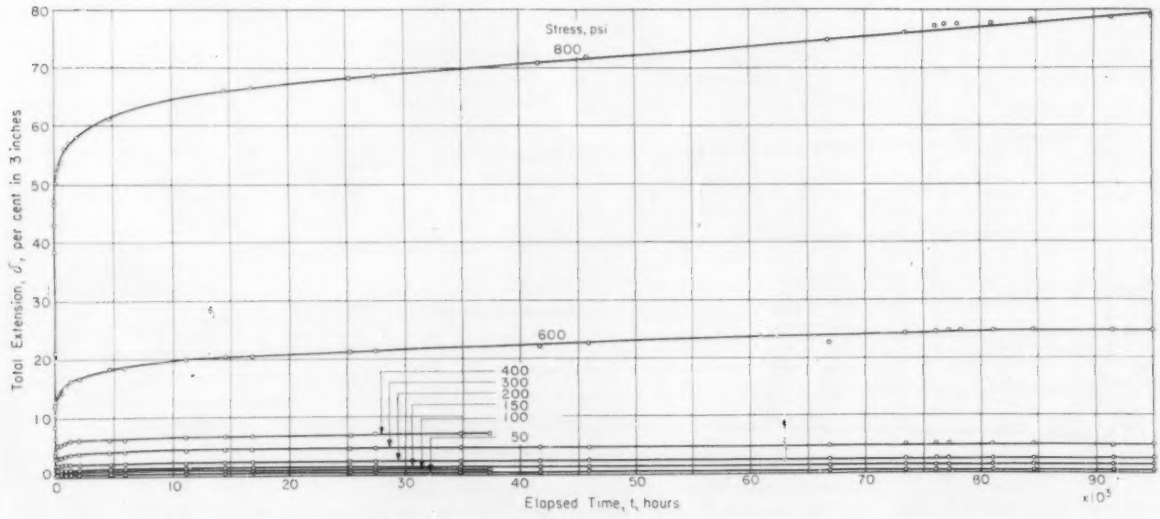

Fig. 2.—Tensile creep of compression-molded polyethylene sheet.
Molded by BTL from lot C raw material, supplier N, tested at 85 F, nominal thickness 0.125 in., melt index 2.2 g per 10 min.

the average of 10 specimens. The data for the first 11,000 hr in Figs. 1 and 2 are identical with those in Figs. 4 and 5 (open circles) of the earlier paper.

Discussion of Data

In the case of the two earliest lots of polyethylene sheet with melt indices of approximately 2.0 g per 10 min (lots B and C, Figs. 1 and 2), at least 20,000 to 40,000 hr were required to establish constant creep rates at the lower stresses, while at the higher stresses no constant creep rate appears to have been attained even after 95,000 hr. In general, for both lots of material, creep stopped after 95,000 hr for stresses of 400 psi and lower. At 50 psi, creep had ceased after the first 20,000 hr. Creep in excess of 0.07 per cent per 10,000 hr appears to have ceased at the stresses shown above after the elapsed time indicated.

Stress, psi	Time After Which Creep Is Less Than 0.07 per cent per 10,000 hr, Approx. hr.
400	90 000
300	70 000 to 80 000
200	70 000 to 80 000
150	20 000 to 40 000
100	5 000 to 40 000
50	500 to 20 000

The second series of tests (lots D and E, Figs. 3 and 4) showed a marked decrease in creep (less extension underload) of polyethylene from supplier N (melt index 0.30 g per 10 min) and a small decrease in creep of polyethylene from supplier M (melt index 0.60 g per 10 min). The third series on the current product (lots F and G,

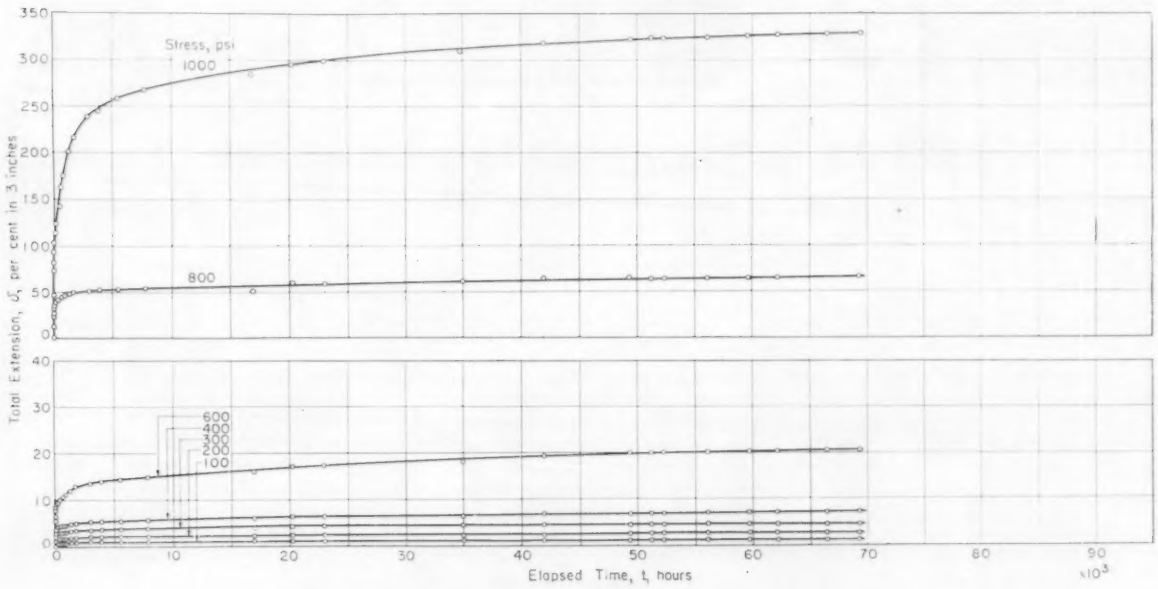

Fig. 3.—Tensile creep of compression-molded polyethylene sheet.
Molded by BTL from lot D raw material, supplier M, tested at 85 F, nominal thickness 0.125 in., melt index 0.60 g per 10 min.

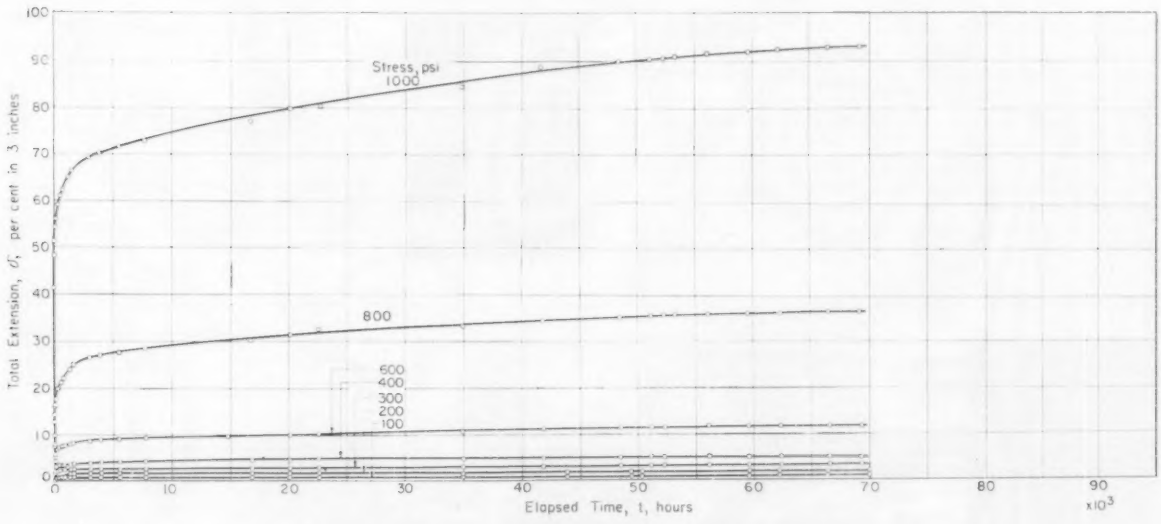

Fig. 4.—Tensile creep of compression-molded polyethylene sheet.
Molded by BTL from lot E raw material, supplier N, tested at 85 F, nominal thickness 0.125 in., melt index 0.30 g per 10 min.

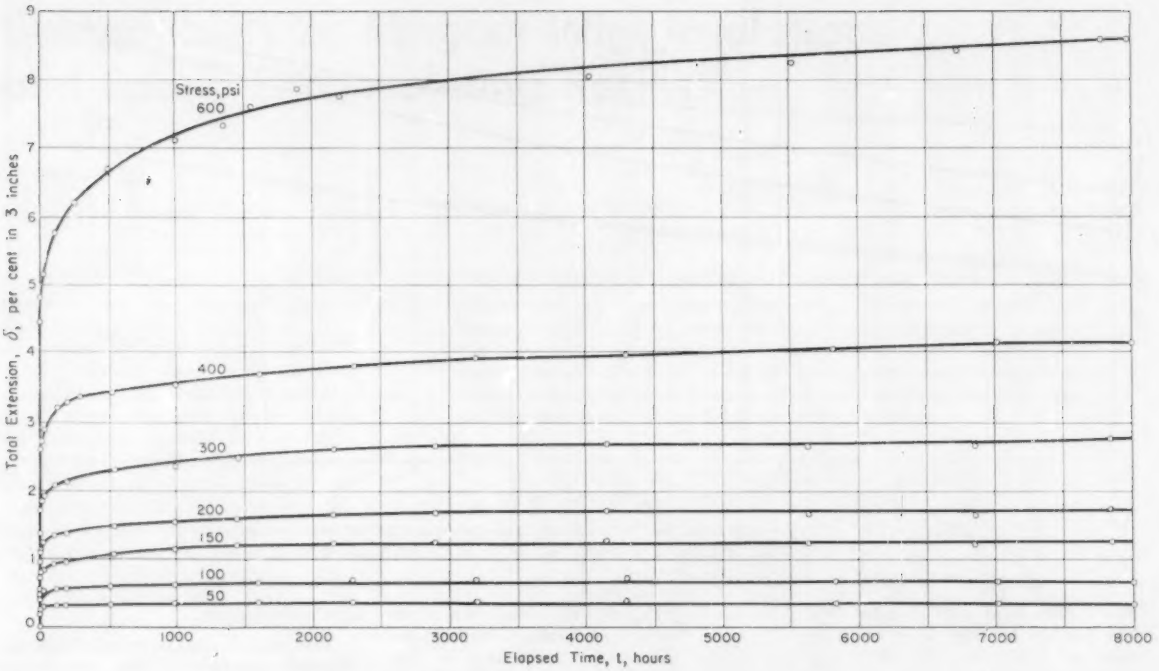

Fig. 5.—Tensile creep of compression-molded polyethylene sheet.
Molded by BTL from lot F raw material, supplier M, tested at 85 F, nominal thickness 0.125 in., melt index 0.25 g per 10 min, current product.

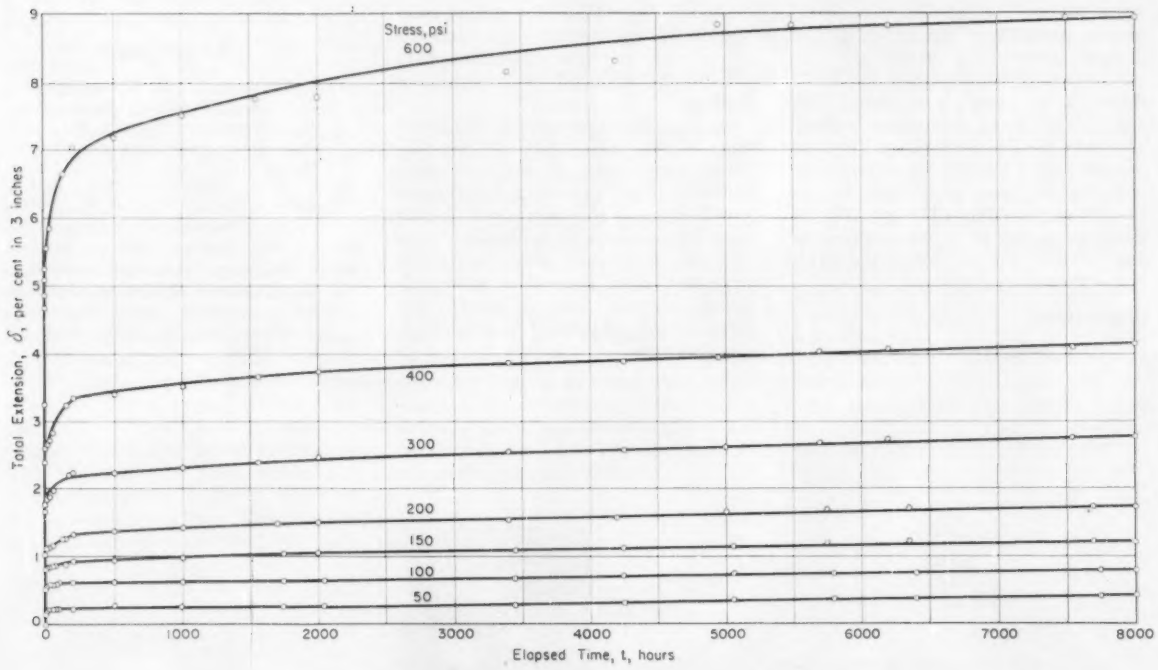

Fig. 6.—Tensile creep of compression-molded polyethylene sheet.
Molded by BTL from lot G raw material, supplier N, tested at 85 F, nominal thickness 0.125 in., melt index 0.33 g per 10 min, current product.

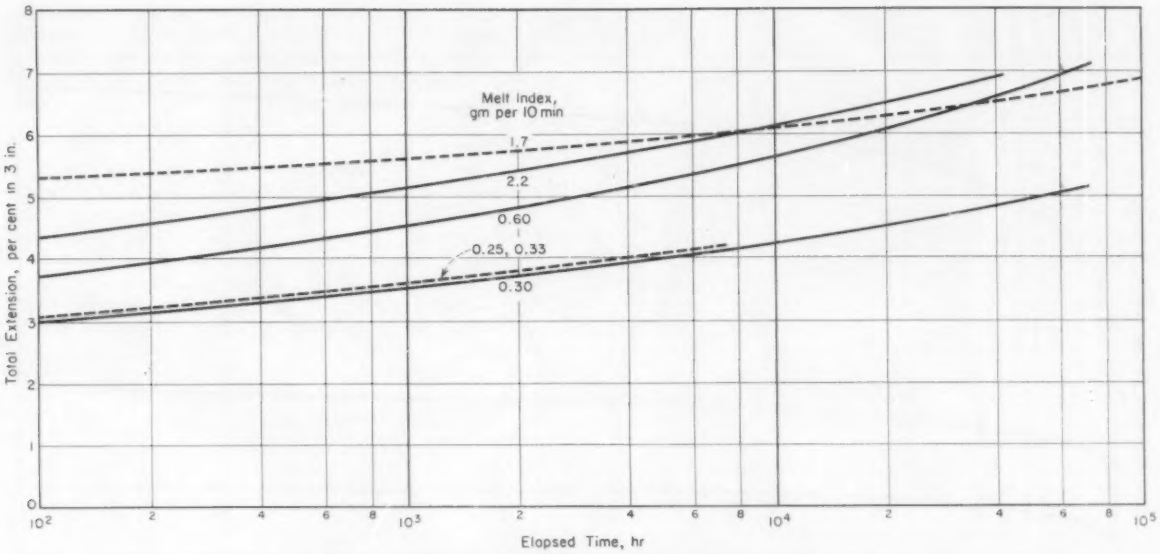

Fig. 7.—Effect of melt index on creep of compression-molded polyethylene sheet.
Molded by BTL, tested at 85 F and 400 psi stress, nominal thickness 0.125 in.

Figs. 5 and 6) showed essentially the same marked decrease in creep for the resins of both manufacturers (melt index approximately 0.30 g per 10 min).

As in the case of the materials of higher melt index, lots B and C, long periods of time are required for the lower-melt-index resins to establish constant creep rates. For lot D, total creep became constant for the 100 to 300 psi loadings after about 40,000 hr. For the remaining loadings and for lot E there was no cessation of creep, even after 70,000 hr of continuous loading. The data for the most recent products studied (lots F and G) fail to show any cessation of creep after 8000 hr, although at the 100, 200, and 300 psi stress levels, the creep rates appear to have become constant within the precision of the test methods.

Conclusions

1. The creep resistance of compression-molded polyethylene appears to be improved by decreasing the melt index of the raw material used in the preparation of the compound (Fig. 7).

2. Creep was observed at all stress levels studied, even at stress levels as low as 50 psi.

3. Periods in excess of 40,000 hr are required to establish constant creep rates at all but the lowest stresses studied; at the higher stress levels minimum creep rates are not established even after 70,000 to 95,000 hr of continuous loading.

4. Equations presented in the literature for the calculation of long-time creep from tests of short duration (1000 to 10,000 hr) will give erroneous results if one of the parameters used for such extrapolation is a constant creep rate as determined from the short-time test, since these data give additional evidence that constant creep rates are not established in such short-time intervals.

Acknowledgment:

The authors wish to acknowledge the valuable assistance of Mr. Alfred Fox in making the creep measurements on the two compounds of recent manufacture.

References

(1) G. R. Gohn, J. D. Cummings, and W. C. Ellis, "The Creep Characteristics of Compression Molded Polyethylene," *Proceedings*, Am. Soc. Testing Mats., Vol. 49, pp. 1139–1151 (1949).

(2) E. A. W. Hoff, P. L. Clegg, and K. Sherrard-Smith, "The Creep of Low Density Polythene," *British Plastics*, Vol. 31, Sept., 1958, pp. 384–389.

(3) R. H. Carey, "Creep and Stress Rupture Behavior of Polyethylene Resins," *Industrial and Engineering Chemistry*, Vol. 50, July, 1958, pp. 1045–1048

Compatibility of Magnet Wire Insulations and Epoxy Encapsulating Resins*

By HENRY LEE

The compatibility of amine and acid-catalyzed epoxy resin encapsulating systems with ten commercial magnet wires is described. Test methods discussed include field tests on a-c motors, chemical resistance tests, motorette tests, and twisted-pair tests. Results of three types of twisted-pair tests are described in detail: some wires are attacked, some are markedly reinforced by certain resin systems. It is concluded that each resin system and wire should be specifically checked prior to use.

ENCAPSULATION of electric motor windings (Fig. 1) is gaining widespread industrial acceptance. The advantages achieved by encapsulating motor windings are: high chemical resistance, high moisture resistance, high fungus resistance, prevention of coil movement and vibration, exclusion of grit and dirt from the windings—all of which add up to markedly increased service life in severe environments. Indeed, encapsulated motors can serve easily in severe chemical atmospheres where standard motor life is only a few months.

Of the many liquid casting resins available, the epoxy resins have proved to be most suitable for motor encapsulation. They are available at reasonable cost as low-viscosity liquids which can be readily converted to tough, solid insulation in a short time after application to the windings. Epoxy resin formulations, designed for stator encapsulation, are characterized by good strength, excellent adhesion, and excellent electrical and chemical resistance.

Numerous formulations are possible with epoxy resins. Many formulation types, *per se*, are not suitable for motor work. However those systems especially developed for motor work are doing an excellent job in the field.

Of the other casting resin types available, none has successfully been adapted for stator encapsulation because of various shortcomings. The liquid unsaturated polyesters have too high shrinkage, poor adhesion to steel during cure, and generally limited heat stability. The saturated polyester resins, such as those used in polyester magnet wire and polyester film insulation, are generally solid resins, and thus are not available, *per se*, as liquids for encapsulation work. The phenolic-casting resins have generally very high shrinkage and impractical cure cycles. The silicone resin and silicone rubber casting resins have the drawbacks of high cost and low adhesion.

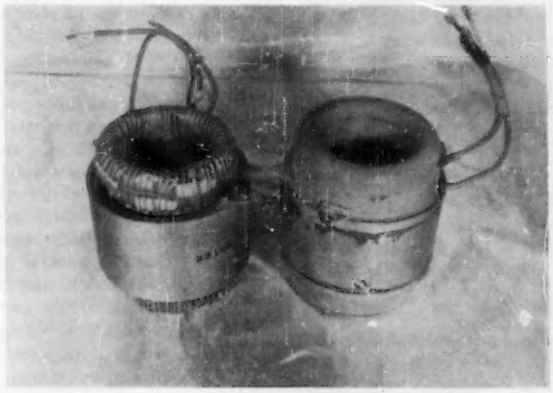

Fig. 1.—Varnished and encapsulated stators (25 hp, 400 cycle).

Epoxy resins became generally available in the United States in 1950 (1).[1] In 1952, the first integral horsepower motors protected by epoxy resin formulations were put into the field (2, 3, 4, 5). At first, thixotropic pastes were applied over the windings; later full pouring or encapsulation was used, as the importance of eliminating dead-air heat traps was recognized and as formulation know-how and application technology was developed.

These early motors were troublesome motors that burned out in the field while doing duty in severe applications, where their service life might normally be a matter of 3 or 4 months. The rewound units were encapsulated and returned to service; in many cases even the first crude attempts at encapsulation easily extended service life to 3 or 4 yr.

In these early encapsulated motors, compatibility of the encapsulating resin with the magnet wire insulation was recognized as a possible problem. Various of the curing agents used for epoxy resins are strong organic bases

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[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

* Presented at the Third Pacific Area National Meeting of the Society, San Francisco, Calif., Oct. 11–16, 1959.

Henry L. Lee, technical director, The Epoxylite Corporation, El Monte, California, has been engaged in development of epoxy resins for electric motors for nine years. He is co-author of the textbook "Epoxy Resins—Their Applications and Technology."

or acids, and could be expected to dissolve or attack the wire insulation to some extent, leading to premature failure of the windings.

To avoid such possible compatibility problems, and since no reliable test method was available to predict field performance, it was necessary at first to use an epoxy impregnating varnish over windings to protect the wire insulation from the more potent curing agents used in the liquid resin system. This apparently was satisfactory; a high percentage of these units have passed the 5-yr mark, despite their use in troublesome environments.

However, as epoxy resin technology developed it was deemed desirable to eliminate the intermediate dip and bake in the impregnating varnish. The reasons for this were:

1. The varnish application was time-consuming, particularly in rewind situations. It added considerable overtime to that already required to rewind and encapsulate a troublesome motor. Such motors were often critical ones, and the customer was anxious to get them back onto the line doing productive duty.

2. On large units, with tight slots, the varnish often served to introduce porosity and incomplete fill in the slots and knuckles of the windings. Even the best varnish, when thoroughly impregnated into the windings, loses 40 to 50 per cent of its fill as the solvents are baked off. Entrapment of solvent bubbles and sealing of portions of the windings tend to prevent complete fill at a later time with the encapsulating media. Heat runs on encapsulated motors have conclusively established that incomplete fill results in sharply reduced heat transfer of the electrically generated heat in the copper out to the stator iron or the air stream.

3. New magnet wire types were becoming more common. A question of compatibility between these new wires and the impregnating varnishes was posed.

4. Encapsulated motors had become available from the original motor manufacturers. These motors were an improvement over varnish-impregnated, open-type, dripproof type, and also the totally enclosed, fan cooled motors for most chemical and contaminated service environments. Because new encapsulated motors are only a few per cent more costly than a varnished, open-type motor, and are much cheaper than totally-enclosed, fan-cooled types, there has been rapid acceptance of the encapsulated motor by industry.

However, there is an implied difference between a varnished motor that burns out, and then is rewound and encapsulated, and a factory-new encapsulated motor. A rewound, encapsulated motor is going into a proved bad spot. Hence, the customer who buys a rewound motor is well satisfied and well repaid when the service life in a severe application is tripled or quadrupled by encapsulation.

But with a "factory-new" motor there is an implied difference that the motor engineer must examine beyond any implied or expressed warranty. The customer tacitly expects a new encapsulated motor to last 10 to 15 yr in a very severe service environment, just as he tacitly expects a varnished motor to operate for 10 to 15 yr in a cool dry atmosphere. Hence, there was a very definite need for a laboratory method of checking compatibility of the insulation system so that, if the epoxy resin encapsulant excluded external contaminants, then the magnet wire insulation would serve its normal useful life period or better. Rather than to solve the new wire and impregnating varnish compatibility problem, it seemed more straightforward to develop a method for solving the wire-encapsulating resin compatibility problem.

When work was first started on the epoxy resin–magnet wire compatibility problem, data were available on the electrical properties of epoxy resins during heat aginga nd humidity (**6, 7**), on the attack of plain copper by epoxy resin systems (**8**), and on magnet wire testing (**9, 10**) but it was necessary to develop or select tests for measuring epoxy resin–magnet wire compatibility.

This paper reviews possible methods of testing for compatibility of magnet wire insulation and epoxy encapsulating resins and outlines the general results achieved by them to date.

There are at least four types of test methods that may be used for testing the compatibility of magnet wire and epoxy encapsulating resins: (1) field tests of motors, (2) chemical resistance tests, (3) motorette tests, and (4) twisted-pair tests.

Field Tests on Motors

Field tests on motors are the final proof of the application. For example, it is known from such tests that the basic incompatibility of polyamine curing agents and certain class B wires will manifest itself by a large hole blown in the end turns of the encapsulated motor within 2 weeks after the motor is put into the field. However, such test programs are drastic and costly. Also, they do not give the results of 10 years' field service in a few hours of laboratory testing, which is one of the requirements of a good test method. Hence, while field tests on motors are the final test, they are not an accelerated test.

Chemical Resistance Tests

Chemical resistance tests consist of immersing specimens of magnet wire into the various chemicals used in epoxy resin formulations, as well as into the uncured manufactured formulations themselves. Testing may be conducted at room temperature or at elevated temperatures.

Measurements may consist mostly of observation of thumbnail softening or visual examination of deterioration of the magnet wire film. Or testing may be as involved as making electrical strength tests on crossed wires immersed in the substance and subjected to a dead load at the crossover point.

Table I presents the results of exposing three types of wires to the five ingredients used in a typical epoxy system, and the mixed "resin" and "catalyst" portions of the final system.

TABLE I.—RESULTS OF CHEMICAL RESISTANCE TESTS ON MAGNET WIRES.

Ingredient[a]	Wire Insulation	Exposure Time and Temperature			
		15 min at 125 C	30 min at 125 C	16 hr at 125 C	9 Months at Room Temperature
No. 1	PVF[b]	No effect	No effect	Softened	No effect
	Epoxy	No effect	Softened	Peeling	No effect
	Polyester	No effect	Softened	Softened	No effect
No. 2	PVF	No effect	No effect	No effect	No effect
	Epoxy	No effect	No effect	No effect	No effect
	Polyester	No effect	No effect	Softened	No effect
No. 3	PVF	Softened	Softened	Peeling	No effect
	Epoxy	Softened	Softened	Peeling	No effect
	Polyester	No effect	No effect	Peeling	No effect
No. 4	PVF	No effect	Softened	Peeling	No effect
	Epoxy	Softened	Softened	Peeling	No effect
	Polyester	No effect	No effect	Peeling	No effect
No. 5	PVF	No effect	No effect	No effect	No effect
	Epoxy	No effect	No effect	No effect	No effect
	Polyester	No effect	No effect	No effect	No effect
No. 6	PVF	No effect	No effect	...	No effect
	Epoxy	No effect	No effect	...	No effect
	Polyester	No effect	No effect	...	No effect
No. 7	PVF	No effect	No effect	...	No effect
	Epoxy	No effect	Softened	...	No effect
	Polyester	No effect	No effect	...	No effect

[a] Ingredients No. 1 to 5 are unmixed reactants, 6 and 7 are the part A and part B of the final resin system prior to cure.
[b] Poly(vinyl formal).

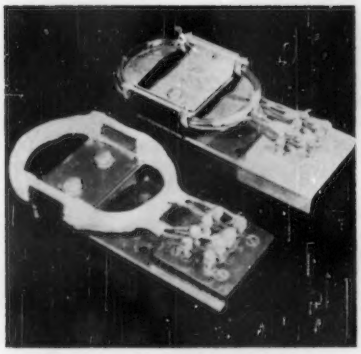


Fig. 2—Comparison of encapsulated and varnished motorette.

In these tests, the poly(vinyl formal) (PVF) and epoxy wires appeared to be attacked the most by the various ingredients and the final formulation. The polyester wire revealed outstanding resistance to solvation, or softening. However, when tested by the various twisted-pairs methods described subsequently, the PVF and epoxy wires were determined to be the most compatible.

Thus, chemical resistance tests may be seen to be somewhat inadequate, as they are difficult to interpret. Many pure chemicals used in epoxy formulations are, in the unreacted or uncombined state, excellent solvents or strippers for the magnet wire film, particularly at elevated temperatures. However, since these chemicals are often used in low concentrations in the formulations, and since the wire is only exposed to them for a short time prior to cure (when the chemicals cease to be separate species but become, instead, members of the crosslinked resin chain) the possibility of wire attack becomes markedly reduced. Thus, chemical resistance tests reflect only the initial effect of the unreacted chemicals but do not indicate the effects of prolonged exposure to the cured system under field conditions. Hence, it is difficult to assess service life of the magnet wire over a 10-yr period based on chemical resistance tests alone.

Motorette Tests

Motorettes, or model motors (Fig. 2), are an AIEE test device (10) whereby insulation systems may be studied in a low-cost, model motor, using high temperatures, to simulate accelerated field service. The method is establishing itself for varnished systems, but has not been widely used on encapsulated systems.

Although obviously less costly than full-scale motors, nevertheless, use of motorettes is an expensive method for screening many formulations and many magnet wires for compatibility.

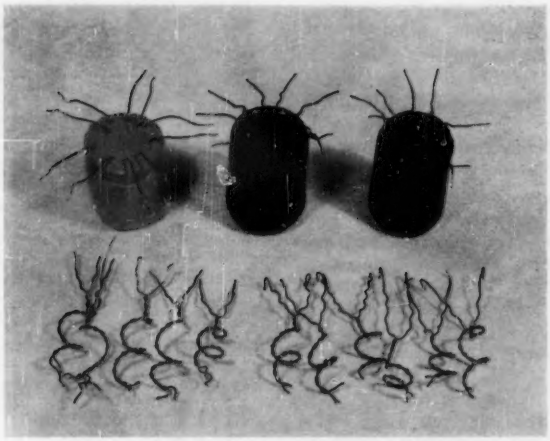


Fig. 3.—Initial twisted-pair specimens.

Undoubtedly, as various specific wires and epoxy resin formulations become better established for encapsulation work, it would be expected that motorette tests would be run on these systems so as to characterize them more fully and to provide correlations to other test methods. Such appears to be the case. It is understood that one of the military services has authorized motorette tests on an epoxy compound which survived a grueling thermal shock and salt-water immersion test on encapsulated motors. Hence, in time, encapsulation compatibility data will undoubtedly be available from motorettes.

Twisted-Pair Tests

The fourth test method for compatibility involves twisted pairs (11). This appears to be the best screening method for compatibility. The specimens are low-cost and easily reproduced. The encapsulation is straightforward, and the test duration is reasonably short. The results, to date, agree very well with the data obtained from field tests.

The fabrication of twisted pairs is defined in reference (11). The reference also discusses their impregnation with varnish, and their thermal aging on an accelerated basis. It provides for various methods of determining end point.

For early encapsulation compatibility work, self-styled twisted pairs such as those shown in Fig. 3 were used and encapsulated in 4-oz jars. Later, upon publication of the AIEE twisted-pairs method (11), standard twisted pairs were adopted and potted in test tubes, the test tube size being selected so as to completely embed the twisted pair except for the leads (Fig. 4). After the encapsulating media are cured, the specimens are then oven-aged at high temperatures to accelerate any attack or degradation phenomena.

Fig. 4.—AIEE twisted pairs encapsulated in test tubes being "high potted."

Three methods of measuring end point have been used and are discussed below.

Test Method No. 1—Specimens are aged at a time and temperature intended to bring them to an approximate 2-kv end-point of a class A or B magnet wire. The specimens are then "high potted" (Fig. 4) to determine the actual dielectric breakdown strength.

The first exploratory tests of compatibility conducted by The Epoxylite Corp. laboratory were of this type. In these first tests, specimens were aged in 3 cycles for a total period of 11.3 hr at 220 C, which is generally equivalent to 7 yr at 105 C, approaching a class A end point. Results of dielectric breakdown tests are shown in Table II.

This test method gives fast results with few specimens. It does not give a history of when the attack occurs, but

merely a relative value at a given time and temperature. Undoubtedly, reliability would be improved by using several test temperatures, as well as lower test temperatures. However, even these preliminary tests gave results which generally followed expected theoretical considerations:

(*a*) Comparison between new and oven-aged untreated magnet wires showed that thermal aging had generally reduced the magnet wire insulation from its initial dielectric strength of 3000 v or greater down to approximately 1000 v. The newer wires, suggested as higher temperature wire than PVF, generally revealed better heat resistance than PVF. The two epoxy-type magnet wires tested revealed better heat-aging resistance than the class B polyesters on the basis of absolute values. On the basis of per cent dielectric strength retained, they aged faster.

(*b*) All wires tested by encapsulating the twisted pairs directly and "high potting" after the specimens had cooled after oven cure or after exotherm cure in the case of room-temperature curing systems, and with no high-temperature oven aging, revealed significantly higher dielectric strength than new, untreated magnet wire twists. The increase in dielectric strength was on the order of 100 per cent. This is attributed to protection afforded by the epoxy wherever it had penetrated, and also to the fact that the epoxy holds the individual strands firmly in place so that they cannot vibrate under the influence of alternating voltage pulsations.

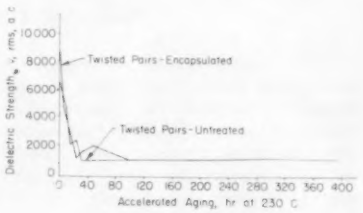
(*c*) The specimens protected with epoxy varnish and then encapsulated and oven-aged bore out earlier tests showing that varnish priming improved the service life of PVF wire somewhat, as compared to encapsulating directly on the windings, when using amine curing agents.

The breakdown value of PVF wire protected by the varnish was almost three times as high as that of the unprotected PVF encapsulated and was 2½ times greater than the oven-aged untreated pairs. However, the other four magnet wires showed essentially no difference between specimens that were protected with the varnish against the encapsulation catalyst and those that were not.

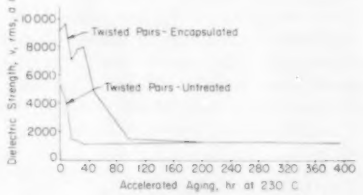
(*d*) In all cases, the coils protected with the acid-type curing agent gave service life equal to or in some cases better than the unprotected coils. In all cases (except for PVF) the acid-type curing agent gave better service life than specimens which had been encapsulated in amine-type curing agents. This is in agreement with the fact that most wire enamels are more acid-resistant than caustic-resistant.

TABLE II.—COMPARISON OF HEAT-ACCELERATED DIELECTRIC-STRENGTH BREAKDOWN PERFORMANCE OF FIVE COMMERCIAL MAGNET WIRES UNDER VARIOUS EPOXY RESIN ENCAPSULATION CONDITIONS. TEST METHOD NO. 1 (see text).

Conditions	Breakdown Strength, v., rms, 60 cps.				
	Poly-(Vinyl Formal)	Polyester I, Class B	Polyester II, Class B	Epoxy-Polyester, Class B	Epoxy-Urea-Formaldehyde, Class B
Unaged, untreated twisted pairs	3800	3200	2700	4800	6000
Untreated, oven-aged, 11.3 hr at 220 C	800	1100	800	2100	1900
Encapsulated, amine cure, unaged	9000	...	7800	...	8800
Varnish-impregnated, encapsulated, amine cure, oven-aged, 11.3 hr at 220 C	1800	500	500	500	800
Encapsulated, amine cure, oven-aged, 11.3 hr at 220 C	700	500	500	500	600
Encapsulated, acid cure, oven-aged, 11.3 hr at 220 C	800	1000	1300	2100	1300



(*a*) Wire type I.



(*b*) Wire type II.

Fig. 5.—Dielectric strength of heat-aged magnet wires.

TABLE III.—COMPARISON OF HEAT-ACCELERATED DIELECTRIC STRENGTH BREAKDOWN PERFORMANCE OF SEVEN MAGNET WIRES WITH COMMERCIAL GRADE STATOR POTTING COMPOUND. TEST METHOD NO. 2 (see text).

Wire Type	Breakdown Time, 2 kv, hr at 230 C (450 F)	
	Untreated Wire	Encapsulated Wire
Oleo-resinous (Essex Black Enamel)	96	83
Poly(vinyl formal) (Essex Formvar)	17	84
Polyamide (Essex Nyform)	17.5	100
Acrylic (Essex Acrylex)	26	20
Epoxy-Urea (Anaconda HEP)	20	46
Polyester, class F	60	66
Single glass polyester, class F	30	200

Test Method No. 2.—In the second method of measuring end point, the dielectric strengths of 5 or 10 per cent of the specimens are measured after given periods of time at an elevated temperature. The method is reasonably fast, but requires more specimens than other methods. It does give an indication of the time during service when possible degrading interactions or attack occur, that is, during cure or as a function of service aging.

In tests conducted by this method, life expectancy curves such as those shown in Fig. 5 and tabulated in Table III were run with various wires all potted in a proprietary compound (Epoxylite #293) developed for motor encapsulation. It may be noted in Table III that some wires are attacked, some are not attacked, and some are reinforced by the epoxy. For example, one wire (Fig. 5(*a*)) is not particularly affected by the epoxy. The difference between the 2-kv service life of the plain wire and the encapsulated wire is within the experimental error of the test method. However, the other wire (Fig. 5(*b*)) reveals a remarkable feature. The presence of the epoxy encapsulating medium provides a fivefold increase in service life. This is all the more remarkable when this statement is interpreted as meaning that encapsulating a class A wire film with a compatible epoxy compound can raise the service life to a class B rating. Such achievements point to numerous economic possibilities in motor and coil manufacture. Although compatible varnishes will often increase the service life of a magnet wire a few degrees, seldom have they been known to raise the service life a whole class.

The possibilities of these phenomena are being studied and established by what may prove to be a more conservative basis, the third method.

Test Method No 3.—The third method of determining end point for twisted pairs is to apply a 1- or 2-kv test to each specimen after each aging cycle of

so many hours, the end point being the number of hours required to reach breakdown. This test method is slower and more time-consuming than the previous two and requires a large number of specimens, but is considered more conservative and more reliable for these very reasons.

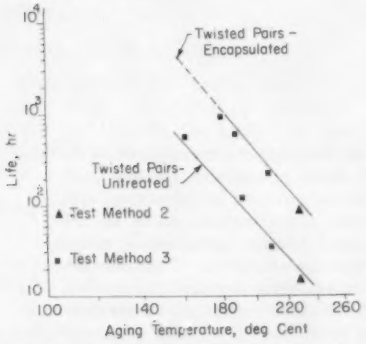


Fig. 6.—Comparison of test methods: dielectric-strength test *versus* time and 1-kv check *versus* time.

However, agreement between the second and third methods for some wires has been very good to date, as shown in Fig. 6, where comparisons of the two sets of data are made, based on 2-kv breakdown values of method 2 and 1-kv value of method 3. The anomaly of why all values of method 2 reach a constant lower limit of about 1.2 kv has not been fully explained. It is theorized that even degraded polymeric films, when not disturbed by vibration or moisture, retain an intrinsic residual dielectric breakdown strength. Comparing the 2-kv point for the second method with the 1-kv point for the third method appears, to date, to give the best correlation. It has theoretical merit in that a given number of 1-kv pulses (each 8-hr cycle) should approach a single 2-kv pulse.

With several wires, notably the polyesters, no correlation was obtained, and certain of these tests are being repeated with predried twisted pairs to determine the possible influence of hydrolysis on the specimens. Very possibly, with polyester wires, the Arrhenius equation may not hold as well as with other wires, due to stereo or orientation factors, and lower test temperatures may be needed. Thus, the tests as presently conducted may be overly severe with some wires, and hence, may actually be disqualifying wires that would perform satisfactorily in the field. Using lower test temperatures is thus indicated for future work to fully qualify these test methods. Ideally, these tests should be within 20 or 30 C of the rated temperature of the wire. However, wires which have been shown to be compatible by the high-temperature tests have stood up well in the field, and thus, if time is of the essence in a preliminary screening, there is some justification for the high test temperatures other than in their preliminary use in development of the mechanics of a new test method.

Conclusions

On the basis of the many wires and compounds tested to date, in addition to field experience, it is concluded that:

1. The AIEE twisted-pair specimen, encapsulated in a test tube, provides a reasonable specimen for compatibility tests. Further work must be done to qualify test temperatures and end-point determination methods.

2. Epoxy resins and curing agent combinations vary widely in their compatibility with each type of wire.

3. Some wires appear to be attacked by the very formulation that reinforces several other wires. Hence, to date, it is not possible to generalize compatibility for a given compound or for a given wire.

4. The present situation unfortunately requires that each compound be actually checked with each proposed wire, lest field compatibility problems occur.

However, the field service life obtainable with a properly encapsulated motor certainly justifies this engineering investigation on the part of the epoxy-compound or wire manufacturer, if not the end user of the wire and compound.

References

(1) H. Lee and K. Neville, "Epoxy Resins—Their Application and Technology," McGraw-Hill Book Co., New York, N. Y. (1957).

(2) L. Rejda, "Epoxy Resins Make Bid for Motor Insulation," *Power*, Nov., 1954.

(3) L. Rejda and H. Lee, "Epoxy Resins," *National Industrial Service Association News*, March, 1955.

(4) L. Rejda and L. Moreland, "Epoxy Resins Solve Tough Maintenance, Problems," *Plant Engineering*, May, 1956.

(5) H. Lee, "The Use of Epoxy Resins to Encapsulate Electric Motors Operating in Severe Service Environments," AIEE Rubber Group Technical Conference, Akron, Ohio, April 13, 1956.

(6) T. Hazen, "Dielectric Measurements on Plastics at High Temperatures," Symposium on Temperature Stability of Electrical Insulating Materials, Am. Soc. Testing Mats. (1954). (Issued as separate publication ASTM STP No. 161.)

(7) H. Graves and A. Pizzino, "Effects of High Humidity on Dielectric Properties of Casting Resins," *Electrical Manufacturing*, April, 1956.

(8) N. Doctor and P. Franklin, "Corrosive Effects of Casting Resins on Bare Copper Wire," *Electronics Equipment*, July, 1956.

(9) E. Brancato and R. Phillips, "Evaluation of Motorette Insulation Systems," *Electrical Manufacturing*, Jan., 1956.

(10) *AIEE No. 1-C*, Test Code for Evaluation of Insulating Materials for Random-Wound Electric Machinery.

(11) *AIEE No. 57*, Test Procedure for Evaluation of the Thermal Stability of Enameled Wire in Air, Jan., 1959.

Effect of Dispersion Techniques Upon the Measured Particle Size and Distribution of Tungsten Powder

By A. I. MICHAELS, T. L. WEAVER, and R. C. NELSON

Particle-size distributions obtained on five tungsten metal powders by three deagglomeration methods (hand shake in medium, carbide block grinding, and metal spatula on glass spatulation) used in conjunction with Cenco Photelometer measurements, plus determinations made on the Sharples Micromerograph are compared. Average particle-size values as measured on the Fisher Sub-Sieve-Sizer are also given. The minimum work was done by the hand-shake technique, which produced the coarsest distribution. The carbide blocks and the Micromerograph gave essentially equal distributions. The metal spatula treatment did the most work and produced the finest distribution. The Sub-Sieve-Sizer readings fell between the carbide-block and Micromerograph average sizes and those obtained by spatulation. A study of the carbide-block working technique at various times is reported for two of the powders. The existence of a deagglomeration plateau at 20 sec of grinding is confirmed and a difference in the behavior of the two powders (indicating a difference in agglomerate strength) is noted.

IT HAS long been a major concern of companies involved in the production or use of tungsten and other refractory metal powders to establish standard methods for the measurement of particle-size distribution. To a large extent this concern has expressed itself in the work of Subcommittee II (Section B) on Refractory Metal Powders of ASTM Committee B-9 on Metal Powders and Metal Powder Products. A previous paper (1)[1] describes the unsuccessful attempt made by this subcommittee, to obtain correlation between the distributions as measured on identical powders by six companies using various turbidimetric sedimentation instruments. The chief cause of failure was reported to be the differences in methods used to deagglomerate the highly agglomerated tungsten powders.

The authors (whose company had participated in the correlation test) felt the need for more information regarding the effect of different working techniques on tungsten powder and undertook a study of three of the more commonly used deagglomeration methods, namely hand shake in medium, carbide block grinding, and metal spatula on glass spatulation. In addition, due to the growing interest of many companies in the comparatively new particle-size distribution instrument, the Sharples Micromerograph, we included measurements obtained on this instrument. Furthermore, in recognition of its use as the standard size control instrument for refractory metal powders, we determined Fisher Sub-Sieve-Sizer readings on the test powders.

Five standard tungsten metal powders produced at different times were analyzed by each of the five techniques: lot Nos. 1239, 1643, 1898, 2426, and 2485. Measurements were taken at different times and by different operators with no attempt made to control or assess

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[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

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THEODORE L. WEAVER has been engaged in studies in the Metallurgical Research Section of Sylvania on particle size analysis, refractory metal powder properties, and nondestructive test instrumentation since joining Sylvania in 1957. He is a graduate of the Williamsport Institute of Technology, and worked in electronics and television prior to coming to Sylvania.

RUSSELL C. NELSON received his D.Sc. degree from the Colorado School of Mines in 1951, and joined the Chemical and Metallurgical Division of Sylvania Electric Products, Inc. in 1953. Since that time he has been actively engaged in research and development on both the extractive and physical metallurgy of tungsten and molybdenum. He is presently head, metallurgical research.

these variables. A minimum of two runs was made for a given sample and method.

Since the carbide block technique is relatively new to us, additional runs were made on two of the powders, Nos. 1239 and 2426, at 5- and 10-sec working times in order to arrive at a clearer picture of the effect of this method.

Particle-Size Techniques

The particle-size techniques used in this study have all been described in previous papers (**1**, **2**, **3**) but are outlined briefly for the sake of completeness.

Hand Shake (1)

A quantity of tungsten powder (approximately 40 mg) is placed in a flask and a small amount of water is added. After some preliminary Photelometer transmission readings with additions of water or powder to obtain an initial transmission of about 30 per cent, the flask is shaken vigorously for 3 min and a portion poured into the Photelometer cell.

Carbide Blocks (1)

Forty-four milligrams of tungsten are placed on the larger of two lapped carbide blocks. The smaller block is placed on top of the powder. The powder is ground for 20 sec by applying a firm pressure to the top block while moving it in a circle of about $\frac{1}{2}$-in. diameter. The powder is then brushed and washed into a flask (with a small amount of water), given a 10-sec shake, and poured into the Photelometer cell. Water is added, as required, to bring the initial transmission to about 30 per cent.

Spatulation (1)

One hundred milligrams of tungsten powder are placed on a flat glass plate, a few drops of water are added and the powder is worked for 6 min with a thin flexible blade metal spatula. A fairly heavy pressure and a circular, frequently reversed, motion is used. Water is added as needed to keep the powder moist during spatulation. The powder is then washed into a flask, water is added, and after a 10-sec shake it is poured into the Photelometer cell. Water is added, as required, to bring the initial transmission to about 30 per cent.

Cenco Photelometer (1, 2)

The Photelometer used with the above three working techniques is a turbidimetric sedimentation particle-size distribution measuring device. Particles settle in a thin flat-walled glass cell, in a liquid medium (water for tungsten). The rate of fall is inversely proportional to the square of the particle diameter in accordance with Stokes' law. A horizontal narrow beam of light measures the concentration of particles in suspension at a fixed distance below the surface of the medium. The variation in this concentration with time (as the particles settle) is a measure of the size distribution of the particles.

Sharples Micromerograph (3)

In this sedimentation instrument, the powder is blown by a preset gas pressure through a deagglomeration slit into the top of a column 220 cm high. The powder settles through the air medium in the column in accordance with Stokes' law and is weighed at the bottom by a servo-electronic balance and recorded on a chart. The deagglomeration slit can be varied from 0 to 250 μ and is actually the cone of space between the surfaces of two concentric cones. The gas pressure to deagglomerate the powders can be varied from 0 to 400 psi. For our work we used pressure and slit settings of 300 psi and 100 μ, respectively.

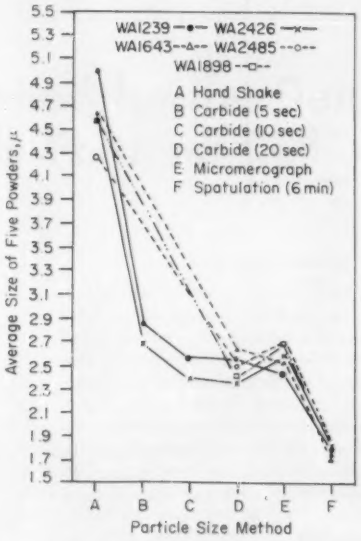

Fig 1.—Particle size method.

Test Results

For each powder-working technique combination (5 powders and 4 techniques give 20 combinations), we computed the average particle size distribution from the total runs made. The average size of the powder was then calculated from this distribution. In Table I we have listed, for each powder and each technique, the number of runs and the calculated average size. The average sizes read on the Fisher Sub-Sieve-Sizer are also given.

Table I is represented in Fig. 1 where we have plotted average particle size *versus* technique for each of the powders (5- and 10-sec carbide block runs for Nos. 1239 and 2426 included for later reference). Also, in Fig. 2 (*a*) to (*e*) we have plotted the average particle-size distribution obtained for each of the various cases. Each figure shows the distributions obtained for one of the powders by the four techniques.

It is clear from a study of these data, especially the distribution plots of Fig. 2 (*a*) to (*e*), that the hand shake consistently produces the coarsest and broadest distribution, with very few particles below 2 μ present and the majority falling between 2 and 5 μ (a substantial amount of coarser par-

TABLE I.—AVERAGE SIZES FOR EACH POWDER-WORKING TECHNIQUE COMBINATION.

Powder	Technique	Number of Runs	Average Size, μ
No. 1239	Handshake	6	5.08
	Carbide	5	2.55
	Micromerograph	2	2.44
	Sub-Sieve-Sizer	4	2.30
	Spatulation	2	1.78
No. 1643	Handshake	2	4.65
	Carbide	4	2.65
	Micromerograph	2	2.53
	Sub-Sieve-Sizer	4	2.35
	Spatulation	2	1.75
No. 1898	Handshake	2	4.60
	Carbide	4	2.42
	Micromerograph	5	2.69
	Sub-Sieve-Sizer	4	2.28
	Spatulation	2	1.80
No. 2426	Handshake	6	4.59
	Carbide	6	2.36
	Micromerograph	2	2.59
	Sub-Sieve-Sizer	4	2.23
	Spatulation	2	1.82
No. 2485	Handshake	2	4.28
	Carbide	4	2.50
	Micromerograph	2	2.70
	Sub-Sieve-Sizer	4	2.33
	Spatulation	2	1.76

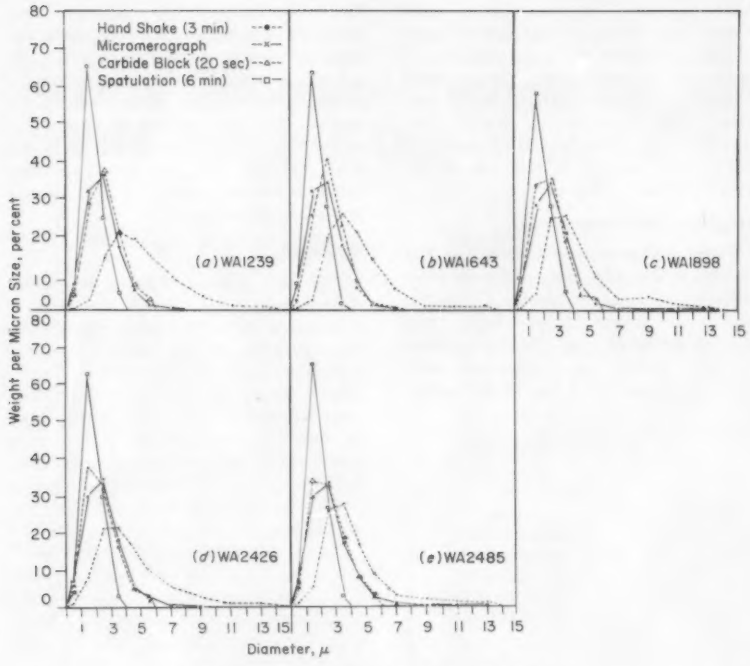

Fig. 2.—Distribution by various methods.
(*a*) Powder No. 1239.
(*b*) Powder No. 1643.
(*c*) Powder No. 1898.
(*d*) Powder No. 2426.
(*e*) Powder No. 2485.

ticles is also present). The average size for all five samples was 4.64 μ. As a technique it does very little work on the powders, probably dispersing large flocculates but not achieving any breakup of even the lightly sintered agglomerates.

The distributions obtained by the carbide blocks (20 sec) and the Micromerograph are probably the same. The differences in readings that occur do not exceed 6 per cent and average only a few per cent, which is of the same order as the reproducibility of these methods. The average sizes for the five powders are 2.50 and 2.59 μ, respectively, and may be considered equal within the observed limits of variation. In both cases there are very few particles above 5μ. The distributions are largely confined to a 1- to 5-μ range with most particles 2 to 3 μ and a substantial minority 1 to 2 μ. Very few particles smaller than 1 μ appear. We have apparently broken down most agglomerates of more than two or three particles. It is probable that very few particles smaller than 1 μ exist unless very strongly sintered. The work done by these techniques is thus considerably more than that accomplished by the hand-shake method, but is still too little to overcome the strongest agglomerate bonds.

The 6-min spatulation produces a distribution with a majority of 1- to 2-μ particles, a minority 2 to 3 μ, and practically nothing else. The average size for the five powders is 1.78 μ. Thus, we may conclude we have either reached the basic and very uniform particle size, or we have agglomerates so strongly sintered as to be in effect basic particles. Further work by spatulation might increase slightly the per cent of 1- to 2-μ particles but should not effect any significant shifts below 1μ.

We have thus a clear progression from light deflocculation and a coarse distribution by hand shake, to medium work with the breakdown of larger and weaker agglomerates by the carbide block and Micromerograph, to almost complete deagglomeration and the finest distribution by a 6-min spatulation.

The Sub-Sieve-Sizer readings are seen to fall between the carbide-block-Micromerograph and the spatulation values, being somewhat closer to the former. The average for the five powders is 2.30 μ, about 0.25 μ below the carbide block-Micromerograph average and 0.50 μ above the spatulation average. From the nature of the Sub-Sieve-Sizer measurement, it is probable that we are reading the total surface area of individual particles, diminished slightly by blocked pore spaces.

The carbide block technique used in these tests was not developed in our laboratories but was patterned on a method originated by Mr. D. A. Pearson of Allegheny Ludlum Steel Co.; consequently, we needed to obtain further information regarding the working time-fineness relation for tungsten powder by this technique. (The 6-min time used in spatulation, for instance, is the point at which a major deagglomeration plateau occurs as determined by experiment (**1**).) We, therefore, had runs made on two of the powders, Nos. 1239 and 2426, at 5- and 10-sec carbide block working times.

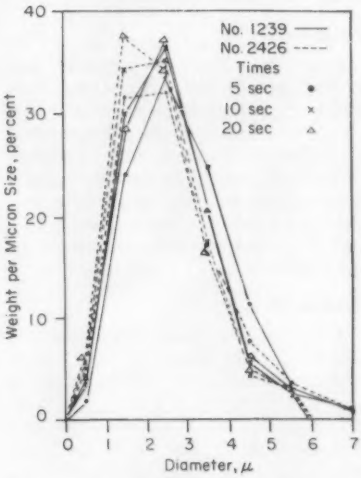

Fig. 3.—Carbide block (5-, 10-, 20-sec) distributions.

The average sizes and distributions obtained at 5, 10, and 20 sec are given in Table II and Fig. 3, respectively. The average sizes are also shown plotted *versus* time in Fig. 1.

TABLE II.—AVERAGE DIAMETERS AT VARIOUS CARBIDE BLOCK WORKING TIMES

Powder	5 sec	10 sec	20 sec
1239.....	2.86	2.57	2.55
2426.....	2.68	2.39	2.36

It is apparent that the 20-sec working time chosen does fall on a deagglomeration plateau as is desirable. However, we note a difference in distribution, not reflected in average size, between the 10- and 20-sec runs on No. 2426 as opposed to No. 1239 which has nearly identical distributions at these two times. This difference is an increase at the longer time in the number of particles less than 2 μ. We are apparently observing a demonstration of a weaker agglomerate bond in 2426 as compared to 1239. This phenomenon is one of importance, related as it is to the choice of a proper degree of working for a given powder intended for a given production process.

Summary

The authors have presented a study of the comparative deagglomeration achieved on tungsten metal powders by a group of particle-size techniques used in the refractory powdered metals industry. We have shown that each technique is capable of producing a distribution which reflects a particular state of agglomeration of the powders. The results were (1) fully agglomerated size for the hand-shake technique, (2) strong agglomerate size for the carbide blocks and Micromerograph techniques, (3) basic particle size for the 6-min spatulation, and, (4) the basic size minus blocked pore-space surface area for the Sub-Sieve-Sizer.

No attempt was made to rate any one technique as "better" than any other. No such rating is desirable for the most part since the choice between these techniques should be made in terms of the intended treatment and applications of the powders, which will determine the degree of agglomeration that is of most importance.

Acknowledgments

We wish to express our gratitude to Mr. H. I. Davidson of the Physical Testing Laboratory for his cooperation in carrying out the reported tests.

REFERENCES

(1) A. I. Michaels, "Turbidimetric Particle Size Distribution Theory: Application to Refractory Metal and Oxide Powders," Symposium on Particle Size Measurement, Am. Soc. Testing Mats., pp. 207–244 (1958). (Issued as separate publication *ASTM STP No. 234*.)

(2) M. N. States, "Specific Surface and Particle Size Distribution of Finely Divided Materials," *Proceedings*, Am. Soc. Testing Mats., Vol. 39, pp. 795–808 (1939).

(3) F. S. Eadie and R. E. Payne, "Particle Size Distribution Analyzed Quickly, Accurately," *The Iron Age*, Vol. 174, Sept. 2, 1954, pp. 99–102.

A Gravimetric Method for the Determination of Barium Oxide in Portland Cement

By C. L. FORD

Analyses for barium oxide were required to add to the data on the cements used in the Long-Time Study of Cement Performance in Concrete (1).[1] Since no method was available for the analysis of cement for barium, one was developed. The method as developed and described herein consists essentially of removing all the constituents of the cement except barium and weighing the latter as the sulfate. The accuracy of the method was verified by analyses of synthetic mixtures of known barium content. The cements used in the Long-Time Study were analyzed and found to contain negligible amounts of barium calculated as the oxide. The detailed procedure is presented in an appendix.

A QUESTION arose recently in connection with the Long-Time Study of Cement Performance in Concrete (1)[1] regarding the possible presence of barium in the cements. It was thought that if barium oxide was present in appreciable amounts, such as 0.10 to 0.20 per cent, it might affect the properties of the cements. Further, since cements contain calcium sulfate, which, when put into solution for analysis would react to precipitate barium sulfate, such a precipitate would be likely to give high results for silica or aluminum (depending on the method used) and for insoluble residue.

Reference to three well-known texts on cement yielded no information of value on the presence or absence of barium compounds in cement. Bogue (2) and Meade (3) do not mention barium. Lea and Desch (4) refer to the existence of barium silicates and aluminates and discuss their cementing properties, but do not state that they are present in portland cement. In spite of this, however, a project was undertaken to determine the amount of barium oxide, if any, present in the cements used in the Long-Time Study.

There are numerous methods for the determination of barium, but none was found specifically adapted to cement. Its determination in cement is complicated by the presence of sulfate ion (derived from the gypsum), which could be expected to cause the partial to nearly complete precipitation of the barium as the sulfate when a cement is dissolved in acid. It was decided, therefore, that a relatively simple method would be to effect complete precipitation of the barium as the sulfate, then to remove all other elements from a solution of a cement by filtration and determine (after further purification) the residual barium as the sulfate. The procedure is described briefly below and in more detail in an appendix.

Procedure

The procedure consists essentially of treating a 1-g sample of cement with water and hydrochloric acid, similar to procedures described in the ASTM Methods of Chemical Analysis of Portland Cement (C 114);[2] adding sulfuric acid; digesting overnight; filtering while still hot in order to avoid precipitation of calcium sulfate; and igniting the residue. Hydrofluoric acid is added to decompose hydrochloric-acid-insoluble material and to volatilize the

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[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

[2] 1958 Book of ASTM Standards, Part 4, p. 63.

C. L. FORD, having retired in April, 1960, was an analytical consultant in the Research and Development Division of the Portland Cement Assn. For the previous 38 years, Mr. Ford worked successively as chemist, chief of Analytical Laboratories, and consultant. His work has included studies of methods for chemical analysis and for the determination of the fineness and density of portland cement. Recent studies have included flame photometric methods for the analysis of cement.

small amount of silica still present. After fusing with potassium pyrosulfate the melt is then dissolved, except for the barium sulfate which, after adding sulfuric acid, is again digested overnight, filtered, ignited to constant weight, and calculated as percentage of barium oxide.

Experimental and Discussion

The accuracy of the method was tested in several ways. First, as a reference standard, a solution was prepared, designed to contain the equivalent of 1.000 g of barium oxide per liter. It was hoped that this concentration could be obtained by preparing a solution containing the theoretical concentration of 1.3580 g per liter of anhydrous barium chloride. The latter was obtained by drying reagent-grade barium chloride hydrate ($BaCl_2.2H_2O$) at 135 C. Analysis of the solution by the usual gravimetric procedure showed that it contained 99.50 per cent of the desired amount of barium. It thus actually contained the equivalent of 0.9950 g instead of the desired 1.000 g of barium oxide per liter. Varying amounts of the standard barium chloride solution were measured into beakers to obtain the equivalent known amounts of barium oxide referred to below.

Experiments were carried out in which (group A) known amounts of barium oxide were analyzed by the above procedure; (group B) calcium carbonate equivalent to 0.640 g of calcium oxide (64.0 per cent of a 1-g sample of cement) was added to known amounts of barium oxide (this was done to determine the possible interference of calcium); and (group C) 1-g samples of Portland Cement Assn. Check Sample No. 1 (no longer available for distribution) were added to known amounts of barium oxide. The barium oxide content of this cement was unknown since no previous work had been done on barium in these laboratories. All values were corrected by subtracting 0.07 mg (the average result of ten blank determinations) from the determined barium sulfate weights before calculating barium oxide values. The latter values were then expressed as percentages of 1-g cement samples. The experiments are discussed below.

Group A—The results of tests of samples containing barium oxide only (added as barium chloride) are shown at the top of Table I. It will be seen that the results obtained for barium oxide differed from the theoretical by an average value of only 0.02 per cent.

Group B—Next in the table are shown the results of tests for the effect of added calcium on the barium determination. The first set of tests in this group was made using calcium carbonate only to provide the equivalent of 64.0 per cent of calcium oxide. The average amount of material found, calculated as barium oxide, was less than 0.01 per cent—a negligible amount. To the other samples of the group containing 64.0 per cent of calcium oxide were added amounts of standard barium chloride solution equivalent to 0.05, 0.10, 0.30, and 0.50 per cent of barium oxide. It will be seen from Table I that the average amount of barium oxide found was slightly low by about 0.01 per cent—probably owing to causes that will be discussed later. Since slightly lower rather than higher barium oxide results were obtained in this group of tests, it may be concluded that calcium was not occluded with barium sulfate.

Group C—At the bottom of Table I are shown the results of analyses of known amounts of barium oxide plus 1-g samples of cement. The first line in this section indicates that the cement itself had a barium oxide content of 0.01 per cent. The other mixtures contained 0.05, 0.10, and 0.30 per cent of barium oxide plus 1 g of cement. The amount of barium oxide found, as shown in Table I, represents the barium oxide found after correcting for the barium oxide value of the cement (plus the average blank). The difference between these average net amounts and the barium oxide added was in each case—0.01 per cent.

It is possible that the barium oxide value of 0.01 per cent shown in Table I, group C, for the cement alone is low by the average amount of 0.01 per cent noted for group B. However, since the other values in group C would probably be low by a similar amount, for comparative purposes the barium oxide content of the cement was not corrected by changing it to 0.02 per cent. Instead, the determined value of 0.01 per cent plus the blank was subtracted from the values for the samples in group C which contained barium oxide. However, if the above correction of 0.01 per cent were used, the average error for this group of tests would not exceed 0.02 per cent, nor would it exceed ±0.015 per cent for any of the individual values. The accuracy of the method will be discussed later in more detail.

The most probable explanation for the slightly low values obtained in some of the tests, and reported in Table I, is that barium sulfate is very slightly soluble under the conditions of the test. Hillebrand et al (5), state that barium sulfate has a solubility of 2.5 mg per liter of cold water. The amount of water used in the above procedure was 400 to 500 ml, which, if cold and free from excess sulfate ion, would dissolve 1.0 to 1.25 mg of barium sulfate—much higher than any of the differences observed in the tests described here.

As described in the procedure, excess sulfate ion was added as sulfuric acid to

TABLE I.—RECOVERY OF KNOWN AMOUNTS OF BARIUM OXIDE DERIVED FROM A STANDARD BARIUM CHLORIDE SOLUTION.

Taken			Barium Oxide Found, per cent[a]						
Barium Oxide, per cent	Calcium Oxide, per cent	Cement, g	Test 1	2	3	4	5	Average	Difference
Group A, Barium Oxide Only									
0.10	...	...	0.09	0.09	0.09	0.08	0.09	0.09	−0.01
0.30	...	...	0.29	0.28	0.28	0.28	0.29	0.28	−0.02
							Average difference		−0.02
Group B, Barium Oxide + Calcium Oxide									
0.00	64.0	...	0.01	−0.01	0.00	0.01	0.00	<0.01	...
0.05	64.0	...	0.04	0.04	0.03	0.03	...	0.04	−0.01
0.10	64.0	...	0.11	0.09	0.10	0.08	0.08	0.09	−0.01
0.30	64.0	...	0.28	0.30	0.30	0.28	0.27	0.29	−0.01
0.50	64.0	...	0.49	0.48	(0.40)[b]	0.48	0.47	0.48	−0.02
							Average difference		−0.01
Group C, Barium Oxide + Cement (PCA Ck 1)[c]									
0.00	...	1.000	0.01	0.02	0.02	0.00	0.01	0.01	...
0.05	...	1.000	0.04	0.05	0.03	0.05	0.05	0.04	−0.01
0.10	...	1.000	0.09	0.09	0.11	0.08	0.10	0.09	−0.01
0.30	...	1.000	0.30	0.28	0.28	0.30	0.30	0.29	−0.01
							Average difference		−0.01

[a] Weights of oxides "Taken" and "Found" are expressed as percentages of 1-g samples of cement (except weights of cement taken). "Barium Oxide Found" was obtained by subtracting a blank value of 0.07 mg (average of 10 tests) from the $BaSO_4$ weights, calculating net $BaSO_4$ to BaO, and converting to percentages.

[b] Value in parentheses is not included in average.

[c] Values for samples containing added barium oxide were corrected for average barium oxide in cement as well as for the average blank value.

repress the solubility of barium sulfate. According to Seidell (6), large amounts of sulfuric acid increase rather than suppress the solubility of barium sulfate. No data were found on the solubility effect of the low concentration (about 4 to 5 volume per cent of concentrated sulfuric acid) used in this study. Extrapolation of Seidell's data —which is a questionable procedure for low concentrations—indicated a greater solubility than was found in any of the tests reported in Table I. Thus, in spite of the theoretical solubility of barium sulfate in both water and acid, the results shown were low by only 0.02 per cent or less. All values in Table I (except for weights of cement samples) are shown as percentages of 1-g samples of cement. The average percentage recovery (not shown in the table) for the group A and group B tests (excluding the 0.05 per cent test which gave a recovery of only 80 per cent) was 95 per cent of the amounts taken.

Limitations, Accuracy, and Precision

The procedure as outlined earlier was not developed to be a micro or even a semimicro method. The intention as stated near the beginning of this paper, was to show whether a cement contains about 0.10 per cent or more of barium oxide, with an accuracy and precision of ±0.015 per cent or less. The results of four or more tests shown in Table I were all within that amount.

The results of analyses of the Long-Time Study cements, presented in Table II and discussed below, all showed a precision of 0.02 per cent or less. Even though the average values were about 0.01 per cent too low, as suggested by the data in Table I, the accuracy still appears to be ±0.015 per cent or less. Although this value represents a possible large error in relation to the amounts of barium oxide found in the Long-Time Study cements, the method did serve to show that the cements contained negligible amounts of barium oxide rather than larger amounts which might interfere with analyses for other constituents. Further, the data shown in Table I indicate that for the larger amounts of barium oxide—0.05 to 0.30 per cent—the actual average difference of the "Found" from the "Taken" amounts was only −0.01 per cent, rather than the possible error of ±0.015 per cent discussed above.

Long-Time Study Cements

Analyses of the Long-Time Study cements for barium oxide were carried out according to the procedure described earlier. The results are shown in Table II. All values are the average of 2 to 4 tests which for most of the samples agreed within 0.01 per cent. The maximum difference between two or more tests was 0.02 per cent. The highest average value found for any of the cements was 0.03 per cent. It is apparent, therefore, that, although the values shown in Table II may be very slightly low, there is no cause for concern regarding the effect of barium on either cement properties or analyses for other constituents of the cements used in the Long-Time Study series.

Conclusions

A procedure has been developed for the gravimetric determination of barium oxide in portland cement. It is based on the solution of, or the volatilization of, all the constituents of the cement except barium. The latter remains insoluble and is separated and weighed as the sulfate. The accuracy of the method was verified by analysis of solutions and mixtures containing known amounts of barium. The cements used in the Long-Time Study were analyzed by this procedure and found to contain negligible amounts of barium calculated as the oxide. Close agreement of values for two or more tests of these cements showed good precision for the method.

TABLE II.—BARIUM OXIDE CONTENT OF LONG-TIME STUDY CEMENTS.

Long-Time Study Cement No.	Barium Oxide, per cent				
	Test				Average
	1	2	3	4	
11	Nil	Nil	...	...	Nil
11T	Nil	0.01	0.01	...	0.01
12	0.01	0.01	0.01	...	0.01
12T	Nil	Nil	...	...	Nil
13	0.01	0.01	0.01	...	0.01
14	0.03	0.01	0.01	0.01	0.02
15	0.03	0.01	0.01	0.01	0.02
16	0.01	0.01	...	...	0.01
16T	0.01	0.01	0.01	...	0.01
17	0.01	0.01	...	...	0.01
18	0.02	0.03	0.03	...	0.03
18TR	0.03	0.03	...	...	0.03
19A	0.01	0.01	0.01	...	0.01
19B	0.01	0.01	Nil	...	0.01
19C	0.01	0.01	...	...	0.01
21	Nil	0.01	0.01	...	0.01
21T	Nil	0.01	0.02	0.01	0.01
22	Nil	0.01	0.01	...	0.01
23	Nil	0.01	0.01	...	0.01
24	Nil	Nil	...	...	Nil
25	Nil	Nil	...	...	Nil
31	Nil	Nil	...	...	Nil
33	Nil	Nil	...	...	Nil
33T	Nil	Nil	...	...	Nil
34	Nil	0.01	0.01	...	0.01
41	0.01	0.01	...	...	0.01
42	0.03	0.01	0.02	0.01	0.02
43	0.01	0.01	0.01	...	0.01
43A	0.01	0.01	0.01	...	0.01
51	0.01	0.03	0.02	...	0.02

APPENDIX

Chemical Analysis of Portland Cement for Barium Oxide

Scope

1. This method of test is intended for the gravimetric determination of the barium oxide content of portland cement.

Apparatus

2. (*a*) Beakers: 250 and 400 ml.
(*b*) Platinum crucibles: 15 ml.
(*c*) Porcelain crucibles: Coors No. 000.
(*d*) Filter paper: 9 and 11 cm; Whatman No. 41 and 42 or equivalent.

Reagents

3. (*a*) Hydrochloric acid, reagent grade.
(*b*) Sulfuric acid, reagent grade, diluted with water 1:1.
(*c*) Sulfuric acid wash solution: reagent grade acid diluted with water 1:19.
(*d*) Hydrofluoric acid, reagent grade.
(*e*) Potassium pyrosulfate, reagent grade.

Procedure

4. (*a*) Weigh and place into a 400-ml beaker 1.000 g of cement previously ground to minus 100-mesh fineness. Add 25 ml of cold water. Disperse the cement in the water and while swirling the mixture, quickly add 3 ml of HCl. Break up any agglomerations of cement with a rubber policeman and stir until it is evident that decomposition of the cement is complete (NOTE 1). Dilute the solution to 50 ml with water and heat the covered mixture to near boiling on a high-temperature hot plate, then digest for 15 min on a steam bath. Immediately di-

lute to 240 to 250 ml (NOTE 2) with either hot or cold water.

NOTE 1.—Small amounts of manganese and iron oxides may remain in suspension, but these will dissolve later.

NOTE 2.—Dilution to at least 240 ml is necessary to prevent precipitation of $CaSO_4$ when H_2SO_4 is added. On the other hand, excessive dilution will tend to prevent complete precipitation of $BaSO_4$.

(*b*) Bring the covered solution to boiling on a high-temperature hot plate and, while boiling vigorously, add slowly from a pipet about 20 ml of H_2SO_4 (1:1). Set the beaker on a cooler part of the hot plate and allow the solution to boil gently for 20 to 30 min, then place the beaker (still covered) on a steam bath overnight (NOTE 3).

NOTE 3.—Heating conditions must be controlled from the time of addition of H_2SO_4 until filtration so that the solution does not either get cold (below about 70 C), or too hot (near boiling) and evaporate to a volume of less than about 240 ml. Either condition will cause the unwanted precipitation of $CaSO_4$.

(*c*) Filter the hot solution through a No. 41 folded together with and inside a No. 42, 11-cm Whatman paper. Scrub the stirring rod with a rubber policeman and wash it. Rinse the beaker onto the papers with hot H_2SO_4 (1:19) wash solution. Scrub and rinse the beaker twice. Wash the filter papers and contents 5 times with hot wash solution, then 5 times with hot water using small portions in each case.

(*d*) Place the filter papers and contents into a 15-ml platinum crucible and slowly char and consume the papers without inflaming. Place the crucible for 10 to 15 min into a muffle furnace at 800 to 900 C. Cool, add 1 drop H_2SO_4 (1:1) and about 5 ml of HF. Heat carefully until the HF and most of the H_2SO_4 have evaporated, then over an open flame until no more SO_3 fumes appear and the bottom of the crucible becomes a dull red. Cool and add about 1 g of $K_2S_2O_7$. Heat over a medium flame until the $K_2S_2O_7$ is melted, then rotate the crucible at an angle over the flame until all the residue on the sides of the crucible is dissolved. Cool, then place the crucible on its side into a 250-ml beaker containing about 1 ml of H_2SO_4 (1:1) and sufficient water to cover the crucible. Heat the covered beaker until the melt (except for $BaSO_4$) is dissolved. With the aid of a rubber policeman, remove the crucible from the solution and wash it thoroughly with water.

(*e*) Proceed as directed in paragraph 4 (*b*), except to add about 25 instead of 20 ml of H_2SO_4 (1:1) (NOTE 4).

NOTE 4.—If a steam bath is not available, the mixture may be digested cold. The amount of calcium present at this stage should be very small, hence the danger of precipitation of $CaSO_4$ with the $BaSO_4$ is negligible. If the solution is digested cold, heat to near boiling before filtration.

(*f*) Filter the hot solution through a 9-cm No. 42 Whatman paper. Scrub and wash the stirring rod, rinse and scrub the beaker, and wash the filter paper and contents as directed in paragraph 4 (*c*). Place the filter paper and contents into a tared No. 000 porcelain crucible and slowly char and consume the paper without inflaming. Ignite the $BaSO_4$ to constant weight in a muffle furnace at 800 to 900 C.

(*g*) Make a blank determination, following the same procedure and using the same amounts of reagents, and correct the results obtained in the analysis accordingly.

(*h*) Calculate the percentage of BaO to the nearest 0.01 per cent, as follows:

$$\text{BaO, per cent} = W \times 65.7$$

where:

W = weight of $BaSO_4$, g, and
65.7 = molecular ratio of BaO to $BaSO_4$ (0.657) multiplied by 100.

REFERENCES

(1) F. R. McMillan and I. L. Tyler, "Long-Time Study of Cement Performance in Concrete," *Proceedings*, Am. Concrete Inst., Vol. 44, pp. 441–453 (1948).

(2) R. H. Bogue, "The Chemistry of Portland Cement," Reinhold Publishing Corp., New York, N. Y. (1955).

(3) R. K. Meade, "Portland Cement," Chemical Publishing Co., Easton, Pa. (1926).

(4) F. M. Lea and C. H. Desch, "The Chemistry of Cement and Concrete," St. Martin's Press, Inc., New York, N. Y. (1956).

(5) W. F. Hillebrand, G. E. F. Lundell, H. A. Bright, and J. I. Hoffman, "Applied Inorganic Analysis," John Wiley and Sons, Inc., New York, N. Y., p. 630 (1953).

(6) A. Seidell (Revision by W. F. Linke), "Solubilities of Inorganic and Metal Organic Compounds," 4th Ed., Vol. I, p. 388, D. Van Nostrand Co., Inc., Princeton, N. J. (1958).

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Bookshelf

The Structure of Matter

Zbigniew D. Jastrzebski; John Wiley and Sons Inc., New York, N. Y. (1959); 371 pp.; Illus.; $11.

Reviewed by H. J. Gilkey, Professor of Theoretical and Applied Mechanics, Iowa State Univ.

A VALID criticism of conventional textbooks on properties of engineering materials is that they are too largely devoted to a listing and discussion of individual products, processes, and properties, factual but lacking in synthesis and coordination.

This book is one of several recent attempts to make the subject less empirical by drawing upon recently acquired knowledge and tying the treatment more closely to the basic concepts of matter in general. It supplies some insight into atomic and molecular structure and the states of aggregation (gaseous, liquid, and solid). Consideration is also given to the distinctive and contributory aspects of crystals, colloids, polymers, and phase transformations in their relation to the various physical properties that underlie engineering design.

The first four chapters (about half the book) are devoted to these basic considerations—the development of the groundwork. As is stated in the preface, these four introductory chapters presuppose a knowledge of general chemistry, general physics, and some calculus, without which assimilation would be difficult. The treatment, especially that in the early chapters, reflects the author's chemical engineering background and approach which, in the writer's estimation, strengthens the presentation and adds to the desirability of the book as a text for all classes of engineering students.

Following an introduction to the mechanical or physical properties in Chapter 4, the different general types of engineering materials are considered in relation to the nature and hazards of normal use. Materials are grouped conventionally including chapters on metals, ceramics and cementing materials, concrete, and protective materials. Timber, asphalts, and tars were covered briefly in earlier chapters. Other chapters relate to electrical and thermal properties; also to corrosion, friction, wear, and lubrication.

The book is well organized and illustrated and its usefulness for both teaching and reference is enhanced by a list of leading questions at the end of each chapter and by lists of references and suggested selective reading.

Although no conscious effort was made to detect the ever-present, inevitable minor errors or discrepancies, the following were noted in passing. Some of these are reiterations of long-standing fallacies which have been passed along from author to author in a sort of "apostolic succession"; others are simply misprints or errors in copying from other sources.

On page 1 in the opening paragraph (line 4) the diameter of an atom is given as approximately 10^{-8} cm (1Å). Two lines further on, it is stated that "the diameter of atoms may vary from 2 to 5 angstrom units."

In Table 4-1 (page 153), Young's modulus for timber is listed as $13(10)^6$ psi, which is, of course, about ten times too great. On the other hand, Poisson's ratio for concrete gives the off-quoted value of 0.1 (see also footnote beneath the table), which is only about half its usual average value.[1]

In Fig. 4–43, page 202, the yield strength for point *B* should evidently be divided by ten. Nor is Fig. 4–44 (page 204) a good portrayal for a material sufficiently ductile to "neck down" prior to rupture.

In the discussion of properties it would have been desirable to have brought out the fact that "modulus of elasticity" (literally "*measure* of elasticity") is a longstanding misnomer. Young's modulus is a measure of stiffness or rigidity—not a measure of elasticity.

The fact that these errors or discrepancies (and unquestionably others of comparable sorts) have crept into a first printing constitutes a justifiable criticism only to the extent that the author and the publishers might, as subsequent opportunity offers, be remiss in their attempts at correction and betterment.

As previously implied, the book is felt to be a valuable addition to the literature of materials. Whether as a text or a reference source it should take its place as one of the better of the recent offerings. It is a desirable addition to the library of anyone concerned with the engineering uses of materials.

[1] Some of the earliest recorded measurements of Poisson's ratio were faulty, due probably to backlash or lost motion in the early mechanical equipment used in measuring the lateral deformations. The lateral strains having only about one-fifth the magnitude of the longitudinal strains, the errors were correspondingly magnified in the ratio of the two. Having gotten into print, such erroneous values have persisted in the literature.

Books reviewed here are furnished by publishers knowing of the broad interests of ASTM. Occasionally reviews are prepared by ASTM Staff members, but in most cases, the books are reviewed by Society members or other individuals who are well informed on the subject at hand. Members who wish to be considered for reviewing books are invited to send in their names and the subjects in which they are interested. Due to customs and mailing considerations, requests from the United States only can be considered.

Copies of these books are not available through ASTM; all inquiries concerning them should be addressed to the publisher.

Modern Methods of Analysis of Copper and Its Alloys

Charles M. Dozinel, translated by G. R. Andrase; Ets. Georges Thone, 15 rue de la Commune, Liege (1960); 239 pp.; $32.

Reviewed by O. P. Case, The American Brass Co., Waterbury, Conn.

THIS WORK is a comprehensive critical review of methods used by metallurgical laboratories for the analysis of copper and its alloys. M. Dozinel has visited the laboratories of most of the important producers of copper and copper alloys in Europe as well as in the United States studying the various analytical methods in use, and his book is a compilation of those methods he considers most practical or "rational." The bibliography covers 767 references and is without a doubt the most comprehensive one in existence restricted to the analysis of copper and its alloys.

Although M. Dozinel addresses himself to the chemist and is therefore principally concerned with chemical methods of analysis, he recognizes the tremendous potential of spectrographic analysis and devotes his first chapter to a review of this subject, including 145 references.

The second chapter reviews briefly the various so-called "wet chemical" methods of analysis: gravimetry, titrimetry, colorimetry, etc., with 131 references appended, including some material on rapid qualitative tests.

Following are 17 chapters, each one devoted to one of the major elements associated with copper or present in its alloys. A variety of methods (gravimetric, electrolytic, polarographic, etc.) for each element are discussed, with particular emphasis on colorimetric methods. Two or three selected procedures are given in detail for each element, as well as an extensive bibliography.

Bibliographies only are given for the so-called "special elements": gold, boron, beryllium, carbon, cobalt, mercury, gallium, indium, sulfur, and titanium, and for inclusions and gases. It would seem that some of these elements are of sufficient importance to warrant fuller treatment. Missing altogether

(*Continued on page 86*)

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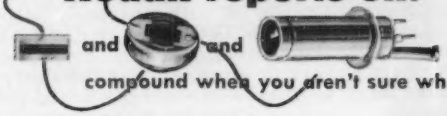

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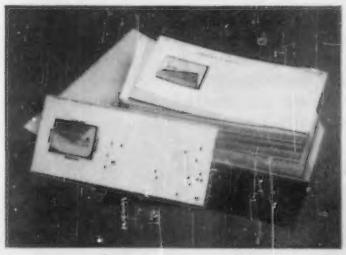
- X-ray diffraction
- Nuclear magnetic resonance spectroscopy
- Fluorescence spectroscopy
- Raman spectroscopy
- Mass spectroscopy
- Gas chromatography
- Miscellaneous analytical methods like polarography
- Miscellaneous physical testing methods.

Aside from creating an impression, these procedures generate strips of paper bearing wiggles. That there would be produced many such useful strips of wiggles to keep and compare had justified the acquisition of the instrumentation. The truer this has proved, the worse you may need help. We ourselves did. Fortunately, as we approached the brink of madness in coping with the sheer volume of spectrophotometric curves generated at the research laboratories of our division, Tennessee Eastman Company, we were able to call on our subsidiary, Recordak Corporation.

The Recordak people are experts at working out systems that combine micro-



Neat, like this.

filming with punched cards. They say they would be willing to help you, too. They suggest you write them at 415 Madison Avenue, New York 17, N. Y., for a copy of "The Use of Aperture Cards for the Consolidation of Spectrophotometric Data."

A devil of a job

Putting together the book "Eastman Organic Chemicals Classified by Functional Groups" was one devil of a job. It should have been done 25 years ago, but we'd kept putting it off and putting it off.

The job was not done by a committee. One man decided how it ought to be done and issued appropriate orders to his helpers. We hope he has done a good job. Some other chemist would have done it some other way. The other way would have seemed far more sensible to the other chemist. That's the trouble with committees (although they *do* have their uses). If a committee had had to agree on the scheme, you would not now be able to obtain a copy of *Eastman Organic Chemicals Classified by Functional Groups* by merely asking Distillation Products Industries, Eastman Organic Chemicals Department, Rochester 3, N. Y. (Division of Eastman Kodak Company).

There are some 3800 Eastman Organic Chemicals for laboratory use. To look one up in our regular alphabetical "Eastman Organic Chemicals List No. 41" for availability, package size, price, structural formula, and MP or BP, you must know what specific compound you want and how we interpret *Chemical Abstracts* nomenclatural rules in naming it. This isn't always easy.

Now, if you first consult "... by Functional Groups," you see gathered together in one handily comprehensible list all the compounds we offer that contain a given functional group. Each compound appears under each of the functional groups it contains.

We think we have done a good thing for chemistry and for business.

Spectroscopy in electronics

We wish we could inspire several dozen more persons to enter the craft of emission spectrography. They would become customers for *Kodak Spectrum Analysis Plates* and *Films* as well as occupants of a secure place in technical society, one of waxing importance.

To convince that the importance indeed waxes we could send copies of a disquisition written by one of our dealers, a gent willing to undertake some deep thinking and digging out of useful information in hope of the favor of an order.

Think of the old days, he suggests, when electronics meant radio and the man at the end of the radio assembly line was given plenty of adjustable resistors, capacitors, and coils on the chassis to adjust in compensation for the unpredictable characteristics of the vacuum tubes. Electronics isn't that way any more, he implies. Today electronics is supposed to assume that its solid-state devices and the cathodes of its vacuum tubes will behave predictably within very narrow limits.

And what sets these limits?

Among other things, the presence or absence of certain chemical elements in the range of parts per billion.

How determined?

By emission spectrography.

Is this easy?

Not particularly.

What's one way to start surveying the techniques?

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This is another advertisement where Eastman Kodak Company probes at random for mutual interests and occasionally a little revenue from those whose work has something to do with science

(*Continued from page 81*)

are lithium, magnesium, thallium, germanium, and zirconium, which may be occasionally encountered in copper alloys.

Following the discussion of methods applicable to the determination of the various elements, a chapter is devoted to "combined procedures" (that is, the determination of several elements from a single sample weighing). Detailed procedures are given for the determination of arsenic, antimony, bismuth, iron, lead, tin, and selenium and tellurium in wire bar copper from one 10-g sample; the determination of aluminum, nickel, and iron in "aluminum-nickel bronze" from a single 1-g sample; and the determination of copper, iron, lead, and zinc in a variety of alloys using a single 0.5-g sample. It is our thought that these combined procedures represent more of a *tour de force* than practical methods of analysis; however the possible savings in time warrant experimentation to determine whether or not this opinion is correct.

M. Dozinel closes his book with a strong plea for "rationalization" of analytical methods on an international scale. By "rationalization," he apparently means selection of an analytical method for a given purpose by careful consideration of accuracy, precision, simplicity, rapidity, and economy. He proposes a cooperative program, such as that of ASTM Committee E-3 on Chemical Analysis of Metals, for the development and testing of analytical procedures on an international level, possibly under the auspices of the International Standards Organization.

The book was originally written in French, and the translation follows the original much too literally for idiomatic English. There are a few mistranslations (for example, "lacquer" for "lake"), several misspelled words, and many typographical errors. In fairness it must be admitted that in general these defects do not seriously impair the clarity of the presentation.

We believe the book will be chiefly of value to industrial laboratories who will find it useful as a convenient, up-to date, comprehensive reference work covering the restricted field of copper and copper alloy analysis.

The Isotope Index

Edited by J. L. Sommerville; Scientific Equipment Co., Indianapolis, Ind. (July, 1959); 119 pp.; $5.50.

Adapted from publisher's description.

THE ISOTOPE INDEX is compiled from the latest suppliers' catalogs and from private communications. It lists the sources of every commercially available isotope as of July, 1959. Included are both stable and radioactive isotopes and more than 1100 labeled compounds of C^{14}, I^{131}, P^{32}, S^{35}, H^2, H^3, and many others. More than 5000 items are listed from US, Canadian, British, French, and German suppliers. The index is primarily a source and purchasing guide and not a technical or engineering book on isotopes. However, some technical data such as half life, radiation, and interfering isotopes have been included. There is a brief section on AEC radioisotope licensing procedures.

The Chemical Analysis of Air Pollutants

Morris B. Jacobs; Interscience Publishers, Inc., New York, N. Y. (1960); xviii and 430 pp.; $13.50.

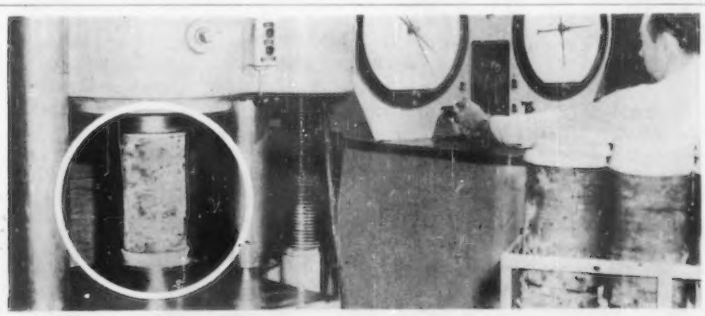
Reviewed by J. Cholak, University of Cincinnati.

THIS BOOK by a well-known author of texts in the field of chemical analysis presents the status of the sampling and analytical procedures being used in air pollution work. Included in the discussion are chapters dealing with such subjects as sampling, measurement of gas volume, soot fall and air-borne particulate matter, gaseous pollutants, principles and techniques for stack sampling and analysis, analysis of motor vehicle exhaust, incinerator flue gas analysis, and radiochemical determinations. Each chapter is provided with a reference list to the literature which appears to give good up-to-date over-all coverage of the work done in the particular field. An appendix includes 13 tables dealing with levels of concentration of certain pollutants in the air of a number of cities.

This book should prove to be a useful general reference for technical and administrative personnel engaged in controlling air pollution. It provides useful background information concerning air pollution problems, and the methods described have apparently been selected with the idea of giving as complete coverage as possible. Preferred methods based on the consensus of use or opinion are not indicated, and a choice of a particular method can therefore be made only with some difficulty. There is a natural leaning toward methods developed in the author's laboratory, and in certain other cases the treatments are rather brief, as for instance the determinations of specific metals in the air. Gas chromatography, which is attracting the attention of air pollution chemists, is omitted from the discussion.

Instrumental methods for continuously monitoring the air are described briefly in Chapter 17. This reviewer feels that the subject deserves far more attention than the author has given it. Nevertheless, the generally excellent coverage of the field and the clarity of description should make the book a valuable addition to the library of all persons doing work in the field of air pollution, whether on the industrial or governmental level.

(*Continued on page 94*)



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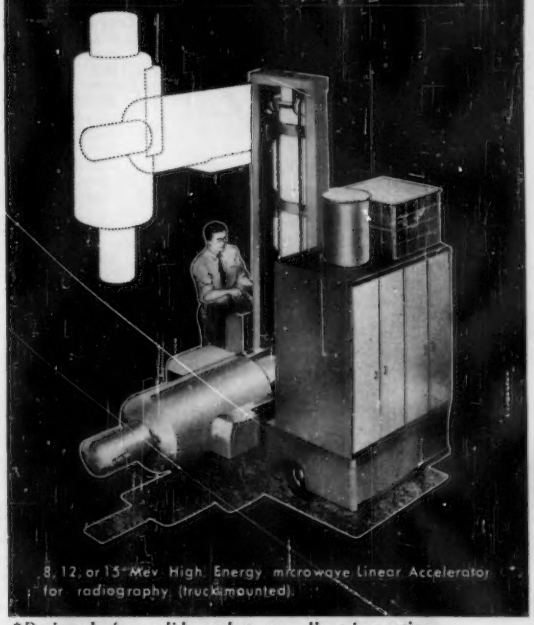

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Newman, Willard L., manager, packaging development, General Electric Co., Bldg. 32-G, Rm. 120, 1 River Rd., Schenectady 5, N. Y.

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Aittama, J. W., chief metallurgist, Snap-On Tools Corp., 8026 28th Ave., Kenosha, Wis. For mail: 7817 28th Ave., Kenosha, Wis.

Bogen, John S., Administrative and Engineering Dept., Erdco Engineering Corp., Addison, Ill.

Carpenter, Edgar R., chief engineer, Wabash Fibre Box Co., 2000 N. 19th St., Terre Haute, Ind.

Cropper, W. V., chief chemist, Standard Oil Co. (Ind.), Box 710, Whiting, Ind. For mail: 566 Harrison Blvd., Valparaiso, Ind.

Denman, Edwin J., city engineer, Box 111, Anderson, Ind.

Ekstrand, Richard L., executive secretary, National Association of Chain Manufacturers, 111 W. Washington St., Chicago 2, Ill.

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Hite, George M., partner, Greeley & Hansen, 14 E. Jackson Blvd., Chicago 4, Ill.

Hoeppner, David W., graduate student, Department of Mining and Metallurgy, University of Wisconsin, 1509 University Ave., Madison 6, Wis. [A]*

Simmons, N. Kenneth, Jr., director, Research and Development Dept., General Filter Co., 923 W. Second St., Ames, Iowa. For mail: RFD 2, Ames, Iowa. [A]

Simon, Lawrence M., product development, Met-L-Wood Corp., 6755 W. 65th St., Chicago 38, Ill.

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Woldenberg, Jay M., president, Testlab Corp., 3398 N. Milwaukee Ave., Chicago 41, Ill.

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Hebblethwaite, Helen K., supervisor of Instron room, B. F. Goodrich Chemical Co., Box 122 (Development Center), Avon Lake, Ohio. For mail: 1103 Washington Ave., Lorain, Ohio.

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Malone, Jean F., manager, sales development, plastic material sales, B. F. Goodrich Chemical Co., 3135 Euclid Ave., Cleveland 15, Ohio.

Meldrum, Gordon, assistant chief metallurgist, Central District, Republic Steel Corp., Massillon, Ohio.

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Verderber, Jacob J., Jr., 2100 Brown St., Lakewood 7, Ohio [A]

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Brown, Howard R., The D. S. Brown Co., Box 158, North Baltimore, Ohio.

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Ilkka, Gust A., Polymers Dept., General Motors Corp., Research Laboratories, 12 Mile and Mound Rds., Warren, Mich.

Komarnitsky, R. S., chief metallurgical consultant, Rockwell-Standard Corp., Research and Development Div., 2445 E. Maple Rd., Birmingham, Mich.

Sydor, Edward J., Cycleweld Cement Products Div., Chrysler Corp., 5437 W. Jefferson, Trenton, Mich.

Zimmerman, Jack W., research chemist, Polymers Dept., Research Laboratories, General Motors Corp., 12 Mile and Mound Rds., Warren, Mich. [A]

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Cotton, Richard A., research director, Millipore Filter Corp., Box 297, Bedford, Mass.

DeSisto, Richard E., engineering laboratory supervisor, Signal Manufacturing Co.,

(*Continued on page 90*)

* [A] denotes Associate Member.
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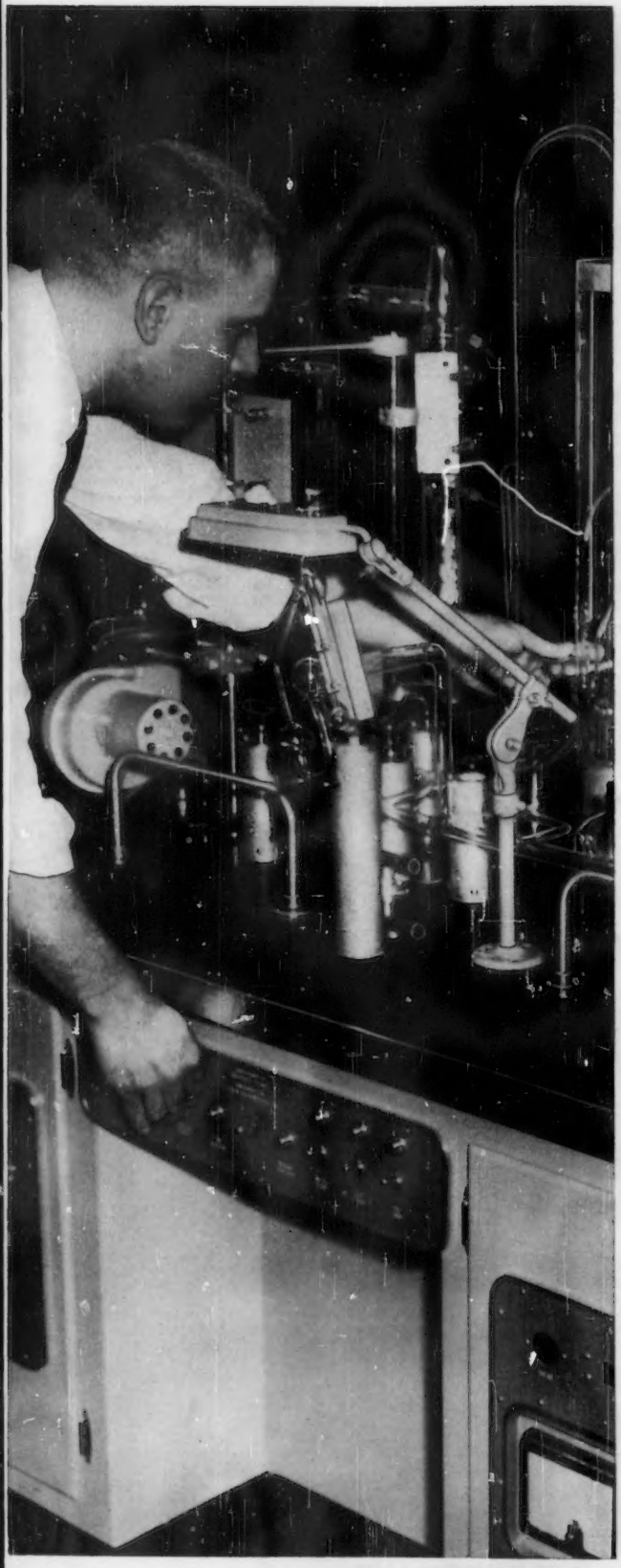

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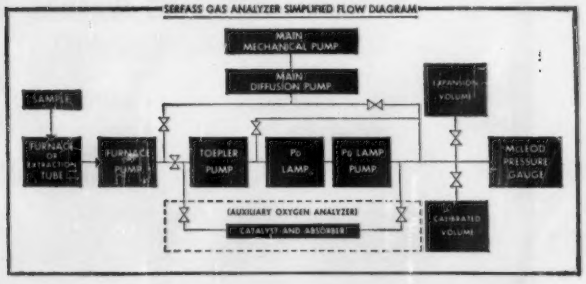

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Nunes, John, materials engineer, laboratory, Watertown Arsenal, Arsenal St., Watertown, Mass. For mail: 23 Golden Ave., Medford, Mass. [A]

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Johnson, Arthur W., industry architectural consultant, National Mineral Wool Assn., Rockefeller Center, 1270 Sixth Ave., New York 20, N. Y. [A]

Johnson, George V., secretary-treasurer, Specialty Paper and Board Affiliates, Inc., 122 E. 42nd St., New York 17, N. Y.

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Nirenberg, Morris, president, Vogue Instrument Corp., 381 Empire Blvd., Brooklyn, N. Y.

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Smoot, Donald P., assistant manager, Technical Service Dept., Stauffer Chemical Co., 14th Floor, 380 Madison Ave., New York 17, N. Y.

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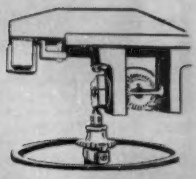

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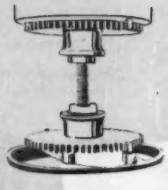

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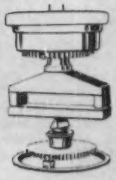

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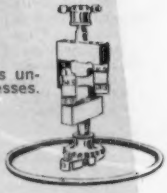
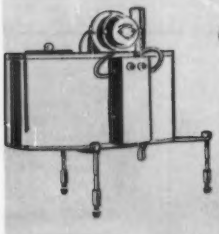


For torsion tests under alternate stresses.



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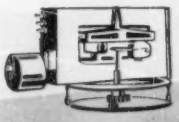

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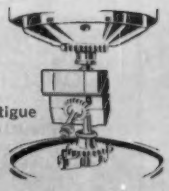

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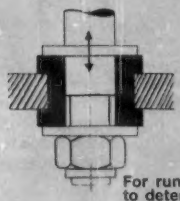

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Skow, Ronald N., region engineer, Linde Co., Division of Union Carbide Corp., 22 Battery St., San Francisco 6, Calif.

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Jackson, Carolen M., mathematician, Engineering Test Branch, U. S. Army Chemical Corps Proving Ground, Dugway Proving Ground, Dugway, Utah. For mail: Box 73, Dugway, Utah. [A]
Quigley, C. G., director, quality and product control, Kennecott Copper Corp., Utah Copper Div., Arthur Plant, Magna, Utah.
Runner, Harold G., bridge designer, Arizona State Highway Dept., 1701 W. Jackson St., Phoenix, Ariz. For mail: 2913 N. 56th Ave., Phoenix, Ariz. [A]
Stevens, Howard G., field engineer, Utah State Road Commission, Box 368, Blanding, Utah [A]

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Meland, Gilbert A., engineer, Brick and Tile Service, Inc., 1021 Arnold St., Greensboro, N. C. For mail: Box 6305, Greenboro, N. C.
Parker, David A., engineer, The Smoot Sand and Gravel Corp., 3020 K St., N.W., Washington 7, D. C.
Roanoke Electric Steel Corp., Joe C. Staton, engineer of tests, Box 1254, Roanoke, Va. [S]†
Underwood, Robert W., executive secretary, North Carolina Concrete Masonry Assn., Box 10533, Raleigh, N. C.

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Pike, E. Grant, research director, Dollinger Corp., 11 Centre Park, Rochester 3, N. Y.
Reilly, Albert F., research director, O-celo Dept., General Mills, Inc., 305 Sawyer Ave., Tonawanda, N. Y.
Shnay, R. C., manager, research and development, Canada Iron Foundries, Ltd., 169 Eastern Ave., Toronto, Ont., Canada.
Vaughan, Lewis W., engineering supervisor, Underwriters' Laboratories of Canada, 7 Crouse Rd., Scarborough, Ont., Canada.

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Batey, Thomas E., Jr., chief, product research, Douglas Fir Plywood Assn., 1119 A St., Tacoma 2, Wash. For mail: 1218 A St., Tacoma 2, Wash.
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Chimenti, Marcello, laboratorist, Société Routiére Khorramchar-Andimeshk, Box 81, Ahwaz, Iran. [A]

Ellestad, Robert E., manager, South Side Concrete Mix, Ltd. Sub. P.O. 28, Calgary, Alta., Canada.

Ellis, B. M., chief engineer, Underwood, McLellan and Associates, Ltd., Box 539, Saskatoon, Sask., Canada.

Fabregat, Francisco J., doctor en ciencias, Consejo de Recursos Naturales no renovables, Niños Héroes 139, Mexico 7, D. F., Mexico.

Filgueiras, Gabriel, Soc. Importadora de Equipamentos, Ltda., Ave. Franklin Roosevelt 39, Rio de Janeiro, Brazil. For mail: Box 4170, Rio de Janeiro, Brazil.

Fisk, Ronald James, regional manager, Portland Cement Inst., 827 Broadway Centre, Heerengracht, Cape Town, South Africa.

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Masuko, Yoshiaki, assistant chief, Steel Research Section, Sumitomo Metal Industries, Ltd., 249 Shimayacho, Konohana-Ku, Osaka, Japan. For mail: 564 Yamamoto, Yao-City, Osaka-Fu, Japan.

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South African Railways and Harbours, T. Long, chief mechanical engineer, Box 1006, Pretoria, South Africa.

Swiss Federal Institute of Technology, Department of Industrial and Engineering Chemistry, Library, Universitaetstr. 6, Zurich 6, Switzerland.

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(*Continued from page 86*)

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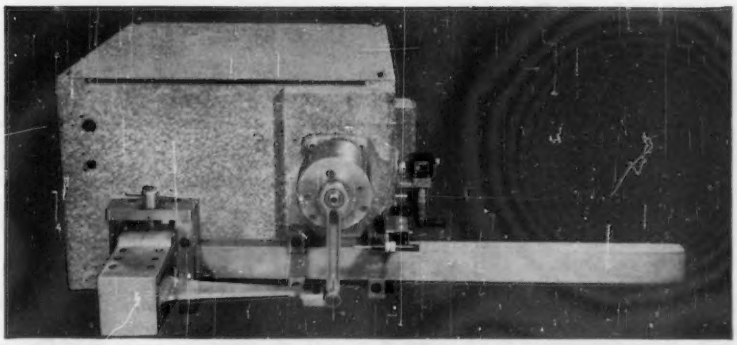
(*Continued on page 100*)



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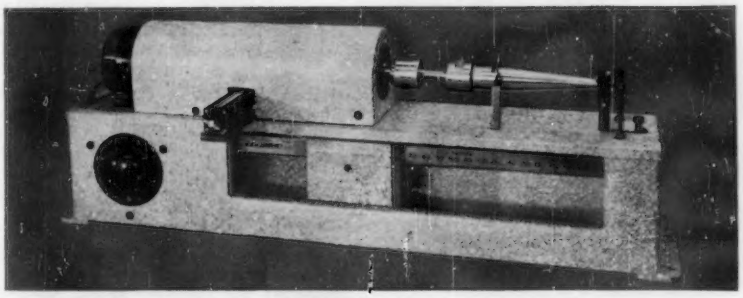

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NEWS OF MEMBERS...

News items concerning the activities of our members will be welcomed for inclusion in this column.

The American Foundrymen's Society at its recent meeting conferred awards to deserving industrial leaders, among whom were two ASTM members. **George A. Timmons,** vice-president, Climax Molybdenum Co. of Michigan, Detroit, Mich., received an Award of Scientific Merit "for notable contributions and services to AFS and the ferrous foundry industry in the fields of heat treatment and alloying of gray iron," and **Victor E. Zang,** vice-president and director, research and development, Unitcast Corp., Toledo, Ohio, was awarded a Service Citation "for tireless and continous efforts on behalf of AFS and the steel casting industry in promotion of cooperative technical endeavor."

The National Academy of Sciences at its recent Annual Meeting elected new members, two of whom are members of ASTM: **Allen V. Astin,** director, National Bureau of Standards, Washington, D. C., and **Augustus B. Kinzel,** vice-president, research, Union Carbide Corp., New York, N. Y. This is one of the highest honors that can be visited upon an American scientist.

United Engineering Trustees, Inc., has announced that **Dr. H. K. Work,** director, Research Div., and professor, research management, New York University, New York, N. Y., has been named director, Engineering Foundation, and **Augustus B. Kinzel,** vice-president, research, Union Carbide Corp., New York, N. Y., has been named as a member of the Board.

Richard H. Aberle recently joined Bodine Pattern and Foundry, St. Louis, Mo., as project engineer. He had been with the American Brake Shoe Co., St. Louis, Mo.

Norbert R. Arant is now forge metallurgist, Ohio Steel Foundry Co., Lima, Ohio. He had been technical director, Roll Manufacturers Inst., Pittsburgh, Pa.

Allen V. Astin, director, National Bureau of Standards, Washington, D. C., recently had another honor bestowed upon him by the National Civil Service League by being named one of the ten outstanding career civil servants in the Federal Government for 1960.

Wallace R. Brode, science adviser to the Secretary of State, Washington, D. C., presented the Priestley Medal Address, "National and International Science," before the 137th National Meeting of the American Chemical Society, Cleveland, Ohio.

R. A. Brown has joined the Esso Research and Engineering Co., Linden, N. J. Previously he was with The Atlantic Refining Co., Philadelphia, Pa.

Charles J. Code, assistant chief engineer, staff, The Pennsylvania Railroad Co., Philadelphia, Pa., an active member of the Society serving on various committees, has been honored by election as vice-president of the American Railway Engineering Assn. at the recent Annual Meeting of the AREA in Chicago. Mr. Code's ASTM activities include Committees A-1 on Steel and E-9 on Fatigue.

M. W. Dalrymple, metallurgical engineer, Bethlehem Steel Co., Bethlehem, Pa., retired June 30, 1960, after 41 years of service with the company. Mr. Dalrymple became an individual member of the Society in 1949, and for many years represented Bethlehem Steel on Committees A-1 on Steel, A-10 on Iron-Chromium, Iron-Chromium Nickel and Related Alloys, and E-4 on Metallography.

Clayton L. Davis, technical service director, Commercial Dept., Universal Atlas Cement, Division of United States Steel Corp., New York, N. Y., has been appointed director, Quality and Technical Services Div., Manufacturing Dept.

M. V. Engelbach, manager, field engineering, The Ruberoid Co., Chevy Chase, Md., retired June 1, 1960. Mr. Engelbach was his company's representative in Society membership and on Committee C-17 on Asbestos-Cement Products.

(*Continued on next page*)

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James F. Fairman, vice-president, Consolidated Edison Co., New York, N. Y., received the 1960 National Society of Professional Engineers Award. The award, which is given for outstanding service to the engineering profession, was made at the Society's annual meeting in Boston in June.

F. R. Fetherston, secretary-treasurer, Compressed Gas Assn., New York, N. Y., was featured as "This Month's Standards Personality" in the ASA Magazine of Standards. Mr. Fetherston represents the Association in Society membership and on Committees D-10 on Shipping Containers, D-3 on Gaseous Fuels, and D-2 on Petroleum Products and Lubricants.

Sallie A. Fisher is now associate director of research, Robinette Research Laboratories, Inc., Ardmore, Pa. She had been a chemist with Rohm & Haas Co., Philadelphia, Pa.

Russell Franks, manager, Marketing Research Div., Union Carbide Metals Co., Division of Union Carbide Corp., New York, N. Y., retired recently. He will, however, continue to serve the company in a consulting capacity. For many years, Mr. Franks represented his company on Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys, and the Joint Committee on Effect of Temperature on the Properties of Metals.

W. V. Friedlaender, research associate, Universal Atlas Cement Div., United States Steel Corp., Buffington Station, Gary, Ind., has been appointed manager, products development and quality analyst, Quality and Technical Services Div., New York, N. Y.

William J. Grede, now chairman of the Board, Grede Foundries, Inc., Milwaukee, Wis., delivered the Charles Edgar Hoyt Memorial Lecture at the 64th AFS Castings Congress and Exposition.

George F. Hodgson, assistant chief engineer, Research and Engineering Dept., Doehler-Jarvis Div., National Lead Co., Toledo, Ohio, has been made director of research, New York, N. Y.

William T. Jarett, prior to becoming senior engineer, Avco Corp., Wilmington, Mass., was senior engineer, North American Aviation, Inc., Los Angeles, Calif.

Richard Jenney, structural engineer, United Engineers and Constructors, Inc., Philadelphia, Pa., retired the end of May. Mr. Jenney represented his company in Society membership for many years.

Augustus B. Kinzel, vice-president, Research, Union Carbide Corp., New York, N. Y., received the Industrial Research Institute Medal for 1960. The medal is given annually by the Institute to honor "outstanding accomplishment in leadership in or management of industrial research which contributes broadly to the development of industry or the public welfare."

Eugene P. Klier, formerly staff metallurgist, National Academy of Sciences–National Research Council, Washington, D. C., is professor of metallurgy, Catholic University, Washington, D. C.

John L. Kuranz, vice-president, Nuclear-Chicago Corp., Des Plaines, Ill., recently made a round-the-world survey of nuclear installations. His trip was devoted to a survey of proposed and existing radioisotope laboratories in Asia, and to meet the scientists in their own countries.

W. M. Layton, manager, Materials and Standards Engineering Dept., Westinghouse Electric Corp., Mansfield Ohio, retired recently. Mr. Layton had been a member of the Society since 1939.

Paul E. Leary is now associated with Central Research Laboratory, Renshed-Mason Co., Detroit, Mich., as technical director. Previously he was technical director, Wolverine Finishes Corp., Grand Rapids, Mich.

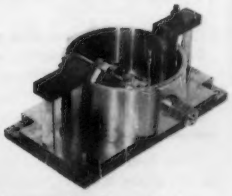
Robert H. Lee, formerly chief metallurgist, Arthur Tickle Engineering Works, Inc., Brooklyn, N. Y., is development engineer, Electric Welding Dept., Linde Co., Newark, N. J.

Sidney Low, formerly works manager, The Chapman Valve Manufacturing Co., Indian Orchard, Mass., is now associated with Gilbert and Barker Mfg. Co., West Springfield, Mass.

Henry Maag is now a partner in SMS Instrument Co., Rensselaer, N. Y. He had been with F. C. Huyck and Sons, Rensselaer, N. Y.

(Continued on page 98)

STATIC FATIGUE TESTS WITH GREGG TENSION RING



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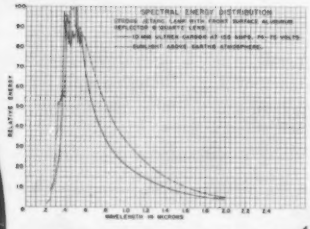

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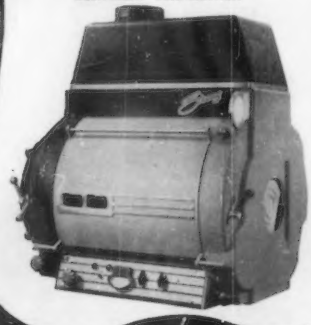

CIRCLE 681 ON READER SERVICE CARD

NEWS OF MEMBERS

(*Continued from page 97*)

Archibald T. McPherson, associate director, National Bureau of Standards, Washington, D. C., recently received the Honor Scroll of the Washington Chapter, American Institute of Chemistry. He was recognized for his encouragement of young scientists and important contributions involving his work at the National Bureau of Standards. Dr. McPherson is a member of and active in the work of numerous societies. In ASTM he has served very constructively as a member of the Administrative Committee on Research. In 1957 he headed the ASTM Delegation to the Inter-American Conference on Standards held in Rio de Janeiro.

John W. Miller, formerly with the Carbide Div., Firth-Sterling, Inc., McKeesport, Pa., is now technical director, Tungsten Alloy Mfg. Co., Newark, N. J.

William C. Mohr is now ceramic engineer, Mosaic Tile Co., Zanesville, Ohio. He had been manager of ceramic technology, Shenango China, Inc., New Castle, Pa.

Meherwan B. Motivala, prior to becoming research engineer, Borg-Warner Corp., Des Plaines, Ill., was assistant application engineer, Claud S. Gordon Co., Chicago, Ill.

David Novick, formerly executive vice-president, Goodkind & O'Dea, Inc., Chicago, Ill., is now associated with Westenhoff & Novick, Inc., Chicago, Ill.

Marshall V. Otis, senior research chemist, Tennessee Eastman Co., Kingsport, Tenn., was the official ASTM delegate at the inauguration of Andrew D. Holt as president of the University of Tennessee on May 14, 1960. The inauguration, which was held in the university's armory field house in Knoxville, was attended by some 5000 persons, including delegates from several hundred colleges, universities, and professional and learned societies. Principal speaker was Grayson Kirk, president of Columbia University.

S. E. Palmer, formerly Edmonton branch manager, The Warnock Hersey Co., Ltd., Montreal, P. Q., Canada, is now works superintendent, Corporation of District of Kitimat, Kitimat, B. C., Canada.

Conrad A. Parlanti is now vice-president, General Communication Co., Boston, Mass. He had been president, Niforge Corp., Boston, Mass.

W. D. Ramey, formerly executive secretary, Mississippi-Louisiana Brick and Tile Mfgrs. Assn., Jackson, Miss., is now executive secretary, Clay Products Association of the Southwest, Austin, Tex.

Henry C. Reinberg, previously chemical engineer, Louisiana State Department of Revenue, Baton Rouge, La., is now chemical engineer, Baton Rouge, La.

Willis E. Rieman is now associated with Micamold Electronics Mfg. Co., Newark, N. J. Previously he was engineer, The Gudeman Co., Chicago, Ill.

Charles W. Roberts, previously soils engineer, Central Scientific Co., Chicago, Ill., is now civil engineer, Engineers Testing Laboratory, Inc., Houston, Tex.

Fred B. Seely, professor emeritus, Department of Theoretical and Applied Mechanics, University of Illinois, presented the first annual F. B. Seely Award at a dinner meeting of the Department on May 2. The award has been established to recognize, each year, the outstanding graduate in the university's new curriculum in engineering mechanics. Prof. Seely served the T & AM Department in teaching and administrative positions for 43 years and is the author of outstanding textbooks in the field. He joined the Society in 1915 and was a member of Committee E-1 on Methods of Testing for 30 years. Prof. Seely presented the first award to **Donald E. Carlson,** an ASTM Prize Award student member.

Milton O. Schur has been named vice-president for research, Packaging Div., Olin Mathieson Chemical Corp., Ecusta Paper Co., Pisgah Forest, N. C. He had been director of research and development.

R. H. Taylor, Scott Testers, Inc., Providence, R. I., has been appointed sales manager.

Walter E. Sicha, chief, Cleveland Research Div., Alcoa Research Laboratories, Aluminum Company of America, Cleveland, Ohio, has been elected a national director of the American Foundrymen's Society for a three-year term.

George H. Spencer-Strong, Pemco Corp., Baltimore, Md., was elected president of the American Ceramic Society at its 62nd Annual Meeting. Mr. Spencer-Strong is secretary of ASTM Committee C-22 on Porcelain Enamel.

Sidney J. Stein, director of research and engineering, International Resistance Co., Philadelphia, Pa., has been elected a vice-president.

Harold C. Stone, prior to becoming director, American Steel Treating Co., Crystal Lake, Ill., was chief metallurgist, Le Tourneau-Westinghouse, Peoria, Ill.

Esteban C. Tarampi, formerly materials engineer and assistant chief, P. J. Kiener Co., Ltd., Cebu, Philippines, is now district engineer, Ghana Government, Ghana, West Africa.

John F. Thompson, a 50-year member of ASTM in 1957, and for a number of years chairman of the executive committee, The International Nickel Co., Inc., has retired as board chairman, becoming honorary chairman. He will continue as chairman of Inco's Executive Committee. He is succeeded as board chairman by **Henry S. Wingate,** who becomes chief officer of the company. **J. Roy Gordon,** formerly vice-president, has been elected president. The senior vice president is **Ralph D. Parker** of Toronto. All of the men have

(*Continued on next page*)

been members and active in various engineering, technical, and scientific societies.

Robert D. Thompson has been named to the newly created post of industrial development coordinator of Taylor Instrument Companies, Rochester, N. Y. Previously Dr. Thompson had been chief development engineer.

S. G. Thyrre is now vice-president, F. L. Smidth & Co., New York, N. Y. Formerly he was vice-president, National Portland Cement Co., New York, N. Y.

E. T. Walton, director of metallurgy, Crucible Steel Company of America, Pittsburgh, Pa., retired at the end of June. Mr. Walton represented his company's sustaining membership in the Society, and also on Committees A-1 on Steel and A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys.

F. W. Warren, technical manager and local director, Dunlop Rubber Co., Ltd., Manchester, England, retired recently. Mr. Warren represented his company in Society membership and also on Committees D-11 on Rubber and Rubber-Like Products and D-14 on Adhesives.

Norman H. Withey is now acting head, Carl C. Crane, Inc., Madison, Wis.

Lincoln T. Work, consulting engineer, New York, N. Y., and a member of ASTM since 1924, was elected president of the Chemists' Club, New York, N. Y.

Bernard C. Yearley, director of applied research, National Malleable and Steel Castings Co., Cleveland, Ohio, has been appointed vice-president of the new General Research, Development, and Engineering Div.

Frederick C. Young, manager, Chemical and Metallurgical Dept., Ford Motor Co., Detroit, Mich., retired recently after completing 50 years of service with Ford. Mr. Young was a member of ASTM Committee A-1 on Steel and also participated in the joint efforts of SAE, ASM, and ASTM.

DEATHS

Max Bachrach, Mamaalian Fiber Consultant, New York, N. Y. (May 1, 1960). Mr. Bachrach joined the Society in 1958 and served on Committee D-13 on Textile Materials.

C. H. Crawford, General Electric Co., Syracuse, N. Y. (recently). Mr. Crawford represented the Electronic Industries Assn. on Committee D-20 on Plastics and was a member of the Joint Committee on Plastic Pipe and Fittings.

Durward R. Evans, Alfred, N. Y. (May, 1960). Mr. Evans was retired from the Western Electric Co., Kearny, N. J. Prior to his retirement, he represented his company on ASTM Committees B-2 on Wrought Iron; E-3 on Chemical Analysis of Metals, which committee elected him to honorary membership; D-5 on Coal and Coke; E-8 on Nomenclature and Definitions; and E-1 on Methods of Testing.

Dozier Finley, Berkeley, Calif. (May 25, 1960). Mr. Finley joined the Society in 1911 and through the years participated in the work of Committees D-1 on Paint, Varnish, Lacquer, and Related Products and D-8 on Bituminous Materials for Roofing, Waterproofing, and Related Building or Industrial Uses. He was a very active member of the Northern California District, having served as vice-chairman from 1938 to 1942 and chairman from 1942 to 1950. As a tribute to his service, the Council elected Mr. Finley to honorary membership in 1954. He also served as Chairman of the General Committee on Arrangements for the first West Coast Meeting, held in 1949.

Perry J. Freeman, Tallahassee, Fla. (November 14, 1959). Prior to his retirement, Mr. Freemen was head materials engineer, Tennessee Valley Authority, Knoxville, Tenn. His membership dates back to 1923, and over the years he was a loyal supporter of the Society. Mr. Freeman's activities included Committees A-1 on Steel, A-5 on Corrosion of Iron and Steel, C-1 on Cement, C-9 on Concrete and Concrete Aggregates, D-4 on Road and Paving Materials, E-5 on Fire Tests of Materials and Construction, D-18 on Soils for Engineering Purposes, ASA Project A-37 on Road and Paving Materials, and the Pittsburgh District Council of which he was chairman in 1932. Committees C-1 and C-9 recognized Mr. Free-

(*Continued on page 100*)

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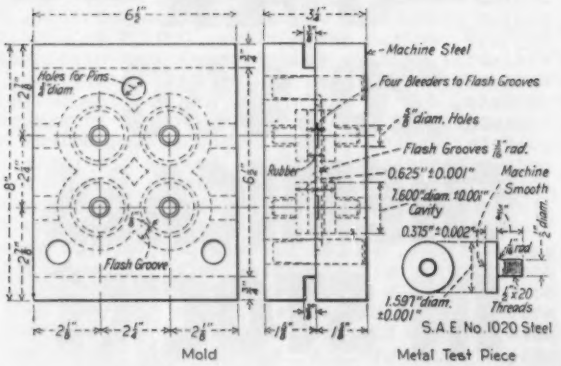

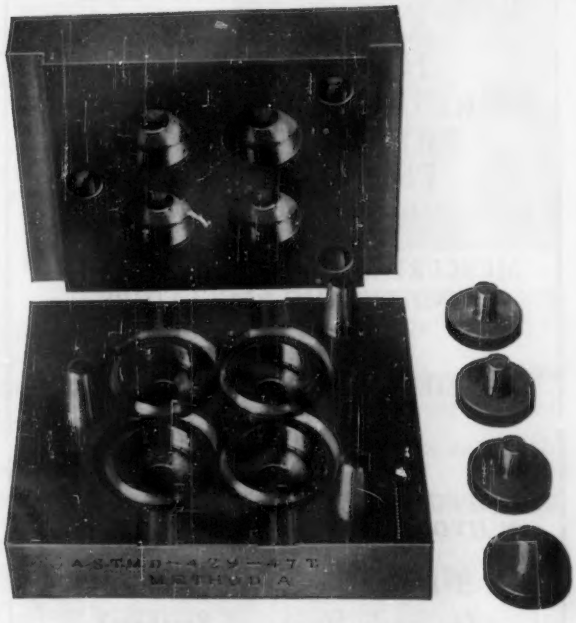

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FOR FURTHER INFORMATION CIRCLE 682 ON READER SERVICE CARD

DEATHS

(*Continued from page 99*)

man's valued contributions by electing him to honorary membership.

Roger L. Johnson, engineer, Copperweld Steel Co., Glassport, Pa. (February 5, 1960). Mr. Johnson joined ASTM in 1954.

Harold R. King, metallurgist, Metal and Alloy Specialties Co., Inc., Buffalo, N. Y. (recently). Mr. King became a member of the Society in 1943, and since 1944 has been a member of Committee B-5 on Copper and Copper Alloys, Cast and Wrought.

A. T. Lillegren, vice-president, Madison-Kipp Corp., Madison, Wis. (May 14, 1960). Mr. Lillegren represented his company on Committee B-6 on Die-Cast Metals and Alloys and was an associate member of Committee E-11 on Quality Control of Materials.

Herbert F. Moore, research professor of engineering materials, emeritus, University of Illinois (April 17, 1960). Prof. Moore, one of the pioneers in the field of engineering materials, was a past-president and honorary member of ASTM and served the Society in many ways during his long and distinguished career.

Henry J. Robar, Public Service Electric and Gas Co., Maplewood, N. J. (April 29, 1960). Mr. Robar represented his company on Committees A-5 on Corrosion of Iron and Steel and A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys.

Ralph Smillie, chief engineer, New York City Tunnel Authority, New York, N. Y. (February 16, 1960). Mr. Smillie was a 30-year member of ASTM.

Earle C. Smith, chief metallurgist and director of research, Republic Steel Corp., Cleveland, Ohio (May 20, 1960). Mr. Smith had been affiliated with the Society for 34 years. In this time he had taken part in a number of ASTM activities. He was extremely active in the National Emergency Steel Project during World War II, and through his support of technical work in the industry and the support he gave his technical associates in participating in ASTM committee work, he rendered distinctive service down through the years.

H. C. Swett, chief metallurgical engineer, Bethlehem Steel Co., Inc., Pacific Coast Div., San Francisco, Calif. (February 10, 1960). Mr. Swett represented his company's sustaining membership in the Society and served on Committee A-1 on Steel.

Henri P. C. Vandecapalle, director, Institut National du Verre, Charleroi, Belgium (January 2, 1958). Mr. Vandecapalle joined the Society in 1954.

J. Alexander Woodward, engineer, The Smoot Sand and Gravel Corp., Washington, D. C. (October 16, 1957). Mr. Woodward had been a member of the Society for almost 30 years.

OTS RESEARCH REPORTS

(*Continued from page 95*)

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(*Continued on next page*)

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Basic Research Résumés—A survey of Basic Research Activities in the Air Research and Development Command, PB 161291, $5.

BOOKSHELF

(*Continued from page 94*)

Magnesium and Its Alloys

C. Sheldon Roberts; John Wiley & Sons, Inc., New York, N. Y. (1960); 242 pp.; $9.

Reviewed by J. W. Caum, ASTM Staff.

THE MODERN metallurgist, physicist, chemist, or engineer needing either isolated facts or a general picture of the science and technology of magnesium should consult this book. It is not intended as a shop manual or as a handbook for the structural designer.

The author has tried primarily to present clearly the knowledge of scientific properties and technology, to emphasize uncertainties which need to be resolved, and to link the two areas in more than a casual manner. The inclusion of highly controversial material has been minimized and properly qualified when presented. Unfortunately the reader may find favorite or interesting subjects missing for this reason.

The chapters cover the physical properties of magnesium, alloy theory and properties, magnesium alloy systems, the deformation of magnesium, time-temperature-dependent alloy phenomena, casting alloys and terminology, wrought alloys and terminology, chemical properties and applications, and the extraction and refining of magnesium. A bibliography and index are also included.

The technological details in the last four chapters are strongly associated with United States practice, in particular that of the Dow Chemical Co. However, some international flavor has been added by referring to the intensive early development of magnesium science in Germany, the important contributions of the British in modern cast alloy development, the outstanding stimulus to advanced metal purification supplied by the Canadian industry, as well as the daring and successful move in the United States to bring magnesium products to high-volume production.

(*Continued on page 109*)

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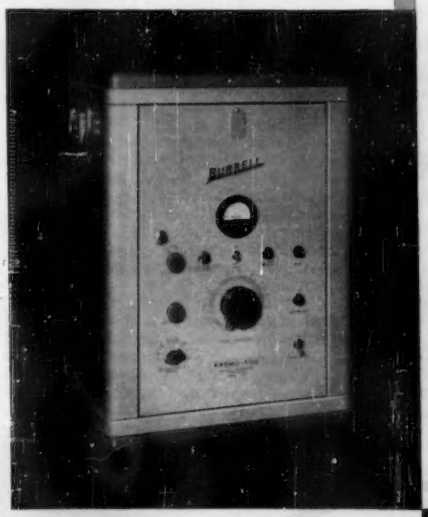

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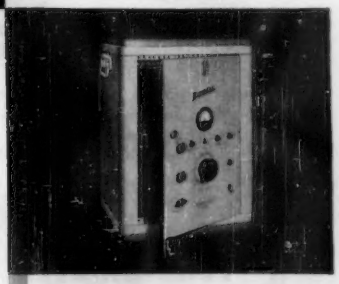

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NEWS NOTES ON
Laboratory Supplies and Testing Equipment

Note. This information is based on literature and statements from apparatus manufacturers and laboratory supply houses. The Society is not responsible for statements advanced in this publication.

LABORATORY ITEMS

Recording pH Meter—A combined pH meter and strip chart recorder is now available. The recorder forms the front panel of the instrument and contains a 63-ft roll of chart paper that will last for 31 days at 1 in. per hr. Other chart speeds are available up to 16 in. per hr by a simple gear change.
Analytical Measurements, Inc. 3412

Voltage Test Sets—A new line of high-voltage a-c test sets in deluxe console cabinets, offering test potentials to 150 kv, has been introduced. Models are available with maximum outputs of 30, 50, and 75 kv with ratings of 1, 2, and 5 kva.
Associated Research, Inc. 3413

Perspiration Tester—An inexpensive, compact new AATCC perspiration tester, Model PR-1, is now available. The unit will test from one to 20 specimens at a time. Separate units are recommended for use on acid and alkaline tests to prevent the possibility of interaction. A single weight will suffice when two or more units are employed in a single laboratory.
Atlas Electric Devices Co. 3414

Uranium Analysis—A new instrument, which is a modification of a B/A direct-reading optical emission spectrometer, makes possible quick, convenient analysis of uranium isotopes U^{235}, U^{236}, and U^{238}.
Baird-Atomic, Inc. 3415

Potentiometers—Two basic models, Type 136F (bronze bearings) and Type 136H (ball bearings), are available. All models feature a unique drum design which permits conformities to 0.1 per cent for all resistance values, up to 16 taps to ±0.25 deg., and precision machined metal housings.
Carter Mfg. Corp. 3416

Air Pollution Tester—A compact portable apparatus for air pollution testing in field work is now available. Developed by Kem-Tech Laboratories for the Department of Health, Education and Welfare, the air pollution field test apparatus is used for determining gaseous and particulate pollutants in the atmosphere.
Central Scientific Co. 3417

Cathode Follower—A new instrument recently developed, the Model 4003 cathode follower, provides faithful reproduction of input signals as low as 1.0 mv over a frequency range of 0.02 cps to 1.0 Mc. Designed for steady-state vibration and shock studies.
Columbia Research Laboratories 3418

Greaseless Vacuum Joint—A new Pyrex brand glass joint developed for laboratory use provides a greaseless, vacuum-tight seal.
Corning Glass Works 3419

Torsion Tester—A redesign of Model CS-100 torsion tester is announced. The new design increases the capacity of the unit from a single specimen to twelve specimens. The purpose of the unit is for determining the stiffness of nonrigid plastics over a wide temperature range.
Custom Scientific Instruments, Inc. 3420

Encoder—A new, small, digital shaft position encoder unit, the TR-705 Minimodule, that will store encoder data "on the fly" at angular velocities up to 120 rpm and provide an output in direct binary code is now available.
Datex Corp. 3421

Insulation Tester—New probes are now available for use with the Model 168, D-K analyzer which now makes possible nondestructive examination of many

(*Continued on next page*)

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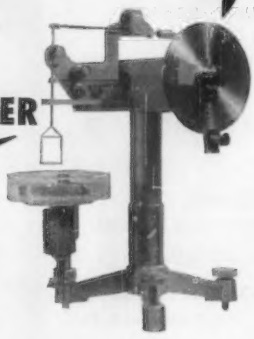

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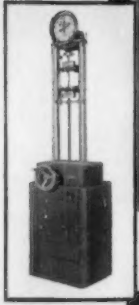

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finished parts made of glass-reinforced plastics and other insulating materials. The D-K analyzer is a direct-reading instrument which measures the dielectric constant and dissipation factor of insulating materials.
Delsen Corp. 3422

Tester—Special tests of wire, ceramics, adhesives, steel, plastics, rubber, springs, etc., often require bulky gripping and related instrument accessories. The new Dillon "Xpandable" work platform permits the proper setup of this equipment by expanding the normal work area almost three times.
W. C. Dillon & Co., Inc. 3423

Chemical Slide Rule—A special slide rule has been developed that will solve problems in chemistry involving the concentration of solutions and the relationship of pressure, volume, and temperature of a gas. It is called the solution concentration and gas law slide rule.
Dyna-Slide Co. 3424

High-Speed Balances—A new line of general-purpose high-speed precision balances designed for small capacity industrial weighing operations is now being offered. Series "K" balances are ruggedly constructed and easy to operate, requiring no special instruction.
The Exact Weight Scale Co. 3425

Fiber Tester—The Fiber Flex Tester is designed to determine flexural strength of fibers.
Fibertest, Inc. 3426

Tensiomat—A semiautomatic counterpart of the manual Fisher surface tensiometer is announced. A small platinum-iridium ring is pulled or pushed through the surface "film" and the force necessary to just break the film is measured. The force applied to the ring can be read directly to ±0.05 dyne per cm. The ring method is specified by ASTM Method D 1331 for determining the surface and interfacial tensions of detergent solutions; also Method D 971 for the interfacial tension of oil against water.
Fisher Scientific Co. 3427

Gas Chromatograph—A Model 500 linear programmed high-temperature gas chromatograph capable of operating to 500 C has been announced. Model 500 nearly doubles the scope of present gas chromatographs and makes possible analyses of low-, medium-, and high-boiling compounds—from 1 to 75 carbon, all in a single run.
F & M Scientific Corp. 3428

Capillary Tubing—A new line of microglass capillary tubing ranging in sizes from 0.0015 to 0.014 in. OD, with standard tolerances held on the micro capillaries to ±0.0002 in. is now being offered.
Friedrich & Dimmock, Inc. 3429

Autocollimator—A new autocollimator for precision measurement of angular position and small linear displacements has been introduced. The autocollimator is an optical tool which combines in a single system the functions of a collimator and a telescope.
Gaertner Scientific Corp. 3430

Strain-Gage Plotter—The new Model 221 high-speed strain-gage plotter, designed for plotting strain or stress tests where loading is fast and data must be acquired rapidly, can be used to plot strain-gage outputs on pressure vessels, rocket engine casings, and other structures. The Model 221 scans and records 20 channels per sec and plots in multiples of 96 channels.
Gilmore Industries, Inc. 3431

Instrument Base—A leveling base that makes it easier for an operator to run tests with an instrument that must rest on a variety of surfaces is available. The base can be used with a wide variety of instruments.
W. & L. E. Gurley 3432

Microtome for Metals—A new, heavy-duty, fully automatic microtome specifically designed to prepare the surfaces of metallic specimens for microscopic study has been developed. The mechanisms can be adjusted to advance the specimen in steps as small as 1 μ.
Wm. J. Hacker & Co., Inc. 3433

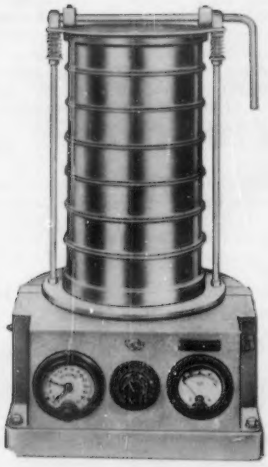
Environmental Chamber—Point control of ±0.1 C in repeatability, speed of response, and on-off differential plus temperature variation of less than 1 C within the 6 cu ft chamber are provided by this new Model 6L-A2-20. A single-chamber cabinet with temperature range of −20 to −85C, the machine affords complete recovery in 10 min with 1000 Btu product load at −65 C.
Harris Refrigeration Co. 3434

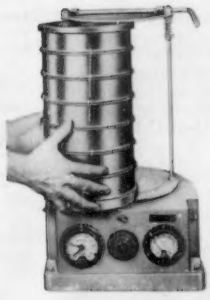
Vacuum Pump—The new Langdon vacuum pump, operating at 1725 rpm, has a capacity of 35 liters per min (free air) and produces an ultimate vacuum of 50 μ.
Hevi-Duty Electric Co. 3435

Oscilloscope—A new 500 MC oscilloscope which provides viewing of repetitive

(*Continued on page 104*)

quick, accurate sieve analysis with





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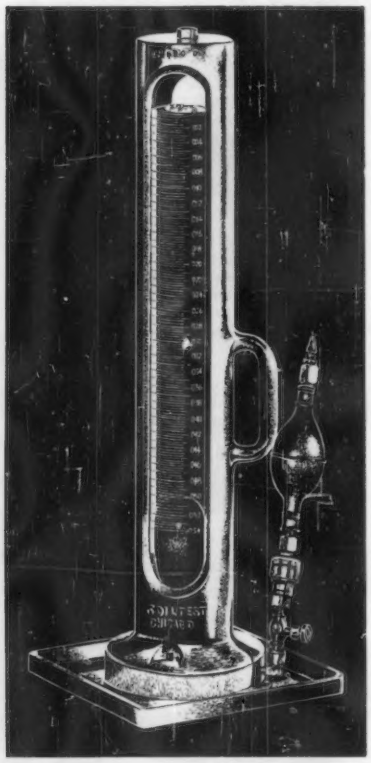

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OTHER SOCIETIES' EVENTS

August 8–12—**American Institute of Electrical Engineers,** Pacific General Meeting, San Diego, Calif.

August 14–17—**National Association of County Officials,** Hotel Fontainebleau, Miami Beach, Fla.

August 14–17—**American Public Works Association,** Public Works Congress and Equipment Show, Manhattan Hotel and Coliseum, New York, N. Y.

August 29–31—**Metallurgical Society of AIME,** Technical Conference, Statler Hotel, Boston, Mass.

August 29–31—**Electron Microscope Society of America,** Marquette University, Milwaukee, Wis.

August 31—September 7—**10th International Congress of Applied Mechanics,** Congress Building, Stressa, Italy.

September 11–16—**American Chemical Society,** New York, N. Y.

September 11–16—**Illuminating Engineering Society,** National Technical Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

September 12–16—**Instrument Society of America,** Conference and Exhibit, Los Angeles, Calif.

September 12–16—**International Council of the Aeronautical Sciences,** 2nd International Congress, Zurich, Switzerland.

September 18–20—**Steel Founders' Society of America,** Fall Meeting, The Homestead, Hot Springs, Va.

September 22–24—**The Institute of Physics** (England), Conference on Theory and Practice of Ultrasonic Inspection, Queens Hotel, Cheltenham, England.

September 25–28—**American Institute of Chemical Engineers,** National Meeting. Hotel Mayo, Tulsa, Okla.

September 26–28—**Standards Engineers Society,** 9th Annual Meeting, Pittsburgh Hilton, Pittsburgh, Pa.

September 26–30—**ISA Instrument-Automation Conference & Exhibit,** Coliseum, New York, N. Y.

September 26–30—**American Welding Society,** Fall Meeting, Hotel Penn-Sheraton, Pittsburgh, Pa.

September 27–29—**TAPPI,** 11th Annual Testing Conference, Pantlind Hotel, Grand Rapids, Mich.

September 27–30—**Prestressed Concrete Inst.,** 6th Annual Convention, Statler-Hilton, New York, N. Y.

September 27–30—**Association of Iron and Steel Engineers,** Cleveland Public Auditorium, Cleveland, Ohio.

LABORATORY ITEMS

(*Continued from page 103*)

millimicrosecond pulses is now available. The new "sampling" scope, Model 185A, is a single package, conceived to permit operation with the convenience and familiarity of a conventional oscilloscope.
Hewlett-Packard Co. **3436**

Concrete Core Measuring—A core length measuring device for accurately determining the height of drilled concrete cores is now being manufactured. This device is the type developed by the Bureau of Public Roads and conforms to the requirements of ASTM Method C 174.
Hogentogler & Co. **3437**

Specific Gravity and Density—An entirely new principle for rapid nondestructive volume, density, and porosity measurements on irregular, powdered, and porous solids is incorporated in the air comparison pycnometer. Will test porosity of clays, bricks, and tiles to give density measurement, per cent porosity, per cent entrapped air, compression packing factors, etc.
Houston Instrument Corp. **3438**

Glossmeter—The Hunterlab D36 distinctness-of-image glossmeter is claimed as the first photoelectric instrument to measure the capacity of surfaces to reflect images. It is applicable to high-gloss materials such as paints, plastics, paper, ceramics, and metals.
Hunter Associates Laboratory, Inc. **3439**

Precision Force Gages—A new series of precision mechanical force gages for measuring tension in a permanent test setup is announced. The force indicator's free-floating transmission rod, which transmits the tension load to a dial indicator, is threaded at its end for mounting in test apparatus or fixtures.
Hunter Spring Co. **3440**

Tuning Fork Oscillator—A new frequency standard, Model JF400 tuning fork oscillator, consists of an electronically driven tuning fork and output filter. The instrument is complete with power supply for operation from 115-v, 60-cycle line.
Industrial Test Equipment Co. **3441**

Load Cell—A new 510 quartz load cell featuring high capacity, excellent repeatability, and utmost rigidity in a small package has been introduced. Measuring less than ¾ in. diam by ¾ in. long, the 510 deflects less than 0.001 in. under a rated maximum load of 4000 lb. Load variation of 0.01 lb can be measured at any level from 0 to 5000 lb.
Kistler Instrument Corp. **3442**

Environmental Test Rooms—A completely new line of walk-in environmental rooms with two temperature ranges: ambient to 140 F, and 0 to 140 F is available. Accuracy is maintained within ±1 F.
Labline, Inc. **3443**

Silica Crucibles—A broad line of ceramic shapes composed of a wide range of ceramic materials including alumina, calcium zirconate, magnesia, mullite, spinel, thoria, zircon, and zirconia has been announced.
Laboratory Equipment Corp. **3444**

Null Detector—A completely new 9844 a-c null detector is designated for use with precision a-c bridges, electrolytic conductivity bridges, current and potential transformer test sets, etc., in research and testing laboratories. The 9844 has five choices of sensitivity over a 10,000 : 1 range with maximum sensitivity of 0.3 μv per scale division for source resistances up to 20,000 ohms.
Leeds & Northrup Co. **3445**

(*Continued on next page*)

Furnace—Recently announced is the Model LP-2472H Dyna-Trol electric furnace having a diversity of applications. Its wide range of temperatures makes it applicable for heat-treating, drawing, glass annealing etc. With, fans removed, temperature can be controlled from 300 to 2300 F; with forced convection fan, 150 to 1875 F.
L and L Mfg. Co. 3446

Linear Scales—Precision linear scales in two standard types are available. Type A, produced by precision direct ruling methods, has each line in true position to $\pm 0.75\ \mu$ over the full scale. Type B, on which the scale is reproduced by a lower-cost photographic process, is accurate to $\pm 2.5\mu$ over the full scale. Lines are opaque on a clear background.
David W. Mann Co. 3447

Scanning Monochromator—Model 235 is a 50 cm vacuum ultraviolet scanning monochromator that guarantees a vacuum of better than 1×10^{-5} mm of mercury. A counter reads actual wavelengths in Ångstrom units from Central Image through 6000 Å, and is accurate to ± 1Å.
McPherson Instrument Corp. 3448

Baths—Close control on temperatures is among the features of two types of precision thermostat baths being produced. The baths—one a thermometer calibration type, the other, viscometer—have transparent sides and a temperature range of 230 C. A circulating plate permits control of temperature fluctuations in the working space to within 0.001 C for water and within 0.005 C for oil.
The Netherlands Trade Commission 3449

Automatic Sample—A new automatic counting system for beta-emitting solid radioactive samples has been announced. The new system is unique in that background (caused by cosmic rays and radioactive materials in the vicinity) is only 2 counts per min, as contrasted with a normal background of 15 to 20 counts per min in conventional systems of this type.
Nuclear-Chicago Corp. 3450

Voltmeter—A 200,000 v d-c voltmeter features two-piece construction for remote metering, convenient direct-reading linear scale, low drain, and reversible polarity.
Peschel Electronics, Inc. 3451

Magnetic Testing—Two magnetic-particle testing units said to provide economical detection of tiny flaws as deep as ½ in. below the surface are part of the new line announced. One unit is stationary, the other mobile. The stationary unit, called the Ferroscope, provides highly sensitive inspection for maintenance work in aircraft, automotive, and railroad machine shops, as well as quality control and production runs of small parts. It detects flaws like inclusions, seams, critical weld defects, and heat treat, grinding, forming, and fatigue cracks.
Picker X-Ray Corp. 3452

Vacuum Pump—The Model 25 vacuum pump, with a capacity of 25 liters per min, offers a guaranteed ultimate vacuum of 0.1 μ, quiet operation, and modern styling.
Precision Scientific Co. 3453

Magnetic Memory Core—The Ramsey Model CH-58 automatic memory core handler is a fully automatic, production type memory cord feeder that grades and sorts standard 80- or 50-mil miniature ferrite cores at feed rates in excess of 10,000 cores per hr, in production testing or limited batch testing and laboratory analysis.
Rese Engineering, Inc. 3454

Robot Chemist—All steps from measurement of the sample to recording of the final determination are performed automatically by variable programmed systems now available, under the general category of "Robot Chemist." Indexing, transfer, storage, centrifuging, incubating, and programming mechanisms combine with standard laboratory equipment in sequential patterns to automate the repetitive, time-consuming procedures in general chemical analysis, clinical chemistry, and biochemistry. Units of the system are obtainable separately as needed, and the central programming unit permits them to be used in different sequences which can be changed quickly and easily.
Research Specialties Co. 3455

Colorimetric Analyzer—A new instrument, the Chemalyzer, incorporating photoelectric comparison in colorimetric analysis, is now available. Standard ranges of accuracy are as follows: hardness, 0 to 3 ppm; residual chlorine, 0 to 1 ppm; residual phosphates, 0 to 30 ppm.
Milton Roy Co. 3456

Oscillograph—A new self-contained 2-channel direct-writing oscillographic recorder that can be either rack mounted in $10\frac{1}{2}$ in. of panel space or housed in a portable case has recently been introduced. The Model 297 is designed for applica-

(Continued on page 106)

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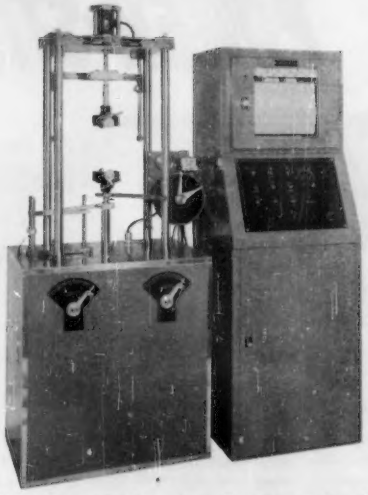

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LABORATORY ITEMS

(*Continued from page 105*)

tions in large instrumentation setups for monitoring and as a bench-top instrument in field work.
Sanborn Co. 3457

Titrator—A special rejection filter placed at the input of the differentating amplifier to sharply improve signal-to-noise ratio and produce an effective suppression of 60-cycle interference is now incorporated in the Sargent Model E automatic titrator and the Model SE Spectro-Electro titrator.
E. H. Sargent & Co. 3458

Vacuum Stopcock—A new Gyco stopcock with Teflon plug designed for high-vacuum work is announced. It is claimed that the O-rings incorporated in the design not only provide a positive seal at each end of the hard borosilicate glass barrel, but seal one side arm from the other.
Scientific Glass Apparatus Co., Inc. 3459

Consolidation Tests—A new consolidation apparatus with automatic data recording has been announced. Called the British autographic consolidation apparatus, the new instrument is reported to reduce considerably consolidation test time. The apparatus has a maximum capacity of approximately 28 tons per sq ft on a standard 2 to 2½-in. diam test specimen.
Soiltest, Inc. 3460

Accelerometer—A linear accelerometer, Series A65, whose size and light weight make it ideally suited for in-flight instrumentation applications, is now available. The instrument responds flat within ±5 per cent from static to 830 cps.
Statham Instruments, Inc. 3461

Optical Proving Rings—High accuracy in load measurement is now possible with an optical proving ring. Load is applied along the axis of the two bosses on the ring. An accurately divided scale contacts the upper edge of the ring and moves up or down through the field of a microscope as the ring is deflected. The microscope is attached to the lower portion of the ring and contains a reticle scale which serves as a vernier, appearing superimposed over the moving scale. The combination of scales is graduated to 0.00002 in.
Steel City Testing Machines, Inc. 3462

Arc—A blown type arc is proving to be the artificial simulator of solar energy in the development and testing of space-vehicle components. Known as the Jetarc, it efficiently collects useful radiation by surface reflectors and concentrates it at the reimaging point from where it can be projected by a quartz objective system in a pattern shaped to fit the work area.
The Strong Electric Corp. 3463

Signal Generator—A versatile new crystal-controlled signal generator, designated as Telonic Model SP-120, capable of producing up to 50 fixed-frequency signals in the 50-kc to 900-Mc range, is now being introduced.
Telonic Industries, Inc. 3464

Container Tester—The column crush tester, a device for measuring the resistance of corrugated and solid fiberboard to edgewise compression, to predict the probable crushing force resistance of the finished containers as they are subjected to crushing forces under warehouse stacking conditions is announced.
Testing Machines, Inc. 3465

Mobile Hardness Tester—Direct-reading unit is designed for conducting Rockwell hardness tests on large or bulky metal components and work specimens that have to be tested at their position in open yards, production areas, or are too heavy for economical hauling to a testing station.
Wilson Mechanical Instrument Div.
American Chain & Cable Co., Inc. 3466

CATALOGS & LITERATURE

Pressure and Temperature Recorders—A new 8-page *Catalog No. 800* describing temperature and pressure recorders is announced. Spiral bourdon tube and bellows type pressure elements are pictured, with materials and performance characteristics listed.
American Machine and Metals, Inc.
U.S. Gauge Div. 6259

Spectrometer—Four-page *Bulletin No. 136* discusses operation and presents specifications on the new Cary-White Model 90 infrared spectrophotometer.
Applied Physics Corp. 6260

Subminiature Strain Gage—A line of subminiature, free-filament wire strain gages, designed for accurate strain measurement on any test surface or material in a wide variety of applications including high temperature, are discussed in a 4-

(*Continued on next page*)

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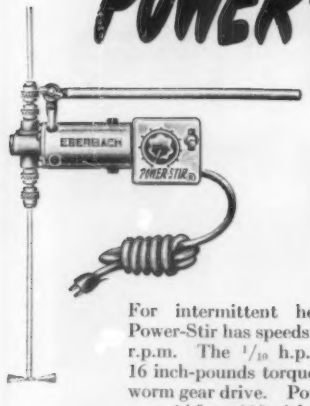

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page, 2-color new product *Data Sheet No. 4330.*
Baldwin-Lima-Hamilton Corp. 6261

Metallography Brochure—Metal Digest No. 2, Vol. 6, serves as an excellent 36-page catalog of polishers and accessories for metallography.
Buehler, Ltd. 6262

Nitrogen Analyzer—A 6-page *Bulletin No. B-258* describing the new Coleman automatic nitrogen analyzer is available. It includes product data and application information for the instrument, which is a fully-automated method of performing the micro-Dumas process of nitrogen determination within 15 min.
Coleman Instruments, Inc. 6263

Temperature Measurement—New 2-page *Bulletin No. R-102* describes and illustrates the operation of the Thermodot radiation thermometer, Model TD-3, which remotely measures temperatures of moving and inaccessible surfaces without contact for a temperature range of 180 t 4000 F.
Comptometer Corp. 6264

Degausser—The new DataTape 5-055A automatic tape degausser is described in a 2-page illustrated *Bulletin No. 1631.* The degausser erases signals from ¼- to 2-in. magnetic tape wound on reels 7 to 14 in. in diam.
Consolidated Electrodynamics Corp. 6265

Vacuum Pumps—A newly developed line of oil-sealed rotary vacuum pumps which produce ultimate pressures to 2×10^{-3} mm of mercury or less, as measured by a McLeod gage, while exhausting against atmospheric pressure is described in *Bulletin 8-15.*
Consolidated Vacuum Corp. 6266

Apparatus Catalog—The new CSI *Catalog No. 60* contains illustrations and brief descriptions of 77 testers or equipment manufactured as standard products.
Custom Scientific Instruments, Inc. 6267

Infrared Detector—*Kodak Ektron Detectors—for the Infrared* is a 4-page brochure which illustrates and describes characteristics of the various types of these products which find application as infrared sensors in instrumentation for process control, analysis, and safety.
Eastman Kodak Co. 6268

Laboratory Catalog—A 344-page, fully illustrated catalog which covers a complete line of laboratory apparatus has been released.
Fischer & Porter Co. 6269

Gas Chromatographic Nomenclature—*Facts & Methods for Scientific Research,* a new quarterly technical publication dealing with gas chromatography and other analysis equipment is now published. The 6-page inaugural issue features work of a special committee of the International Union of Pure and Applied Chemistry.
F & M Scientific Corp. 6270

Infrared Linear Source—An 8-page, 2-color *Bulletin No. 59-240* gives full information on pre-engineered modular oven components incorporating T-3 quartz lamps, quartz tubes, or metal rods as sources for infrared heat.
Fostoria Corp. 6271

Microscopy—Copies of *High-Temperature Microscopy* by Drs. Gabler and Wurz are available free-of-charge.
Wm. J. Hacker & Co., Inc. 6272

Laboratory Bulletin—Recorders, colorimeters, and other laboratory equipment are described in an 8-page *Bulletin No. 1-60.*
Harshaw Chemical Co. 6273

Air Test Equipment—Catalog describes pitot tubes, manometers, thermometers, and other air test equipment.
E. Vernon Hill & Co. 6274

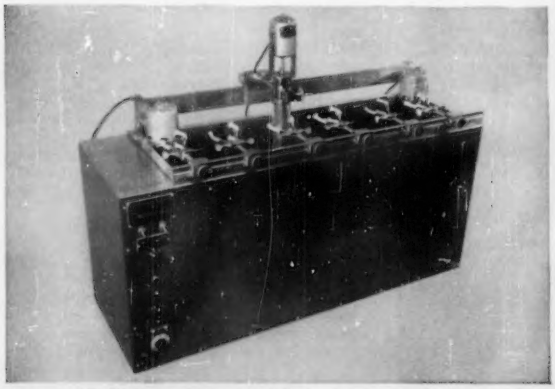
Digital Readout System—The new Instron dynamic digital system consists of a standard universal testing instrument equipped with encoders, memory storage units, and associated assemblies. Through binary decimal code, the system converts the information normally presented in graphic form directly into automatic printing digital form. Described in *Brochure No. 1.*
Instron Engineering Corp. 6275

Distance Meter—A 2-page illustrated catalog sheet is now available describing the Type DM-100 distance meter, a portable and lightweight precision instrument. The catalog sheet, *Bulletin WK-DM-100,* gives a general description of the distance meter, applications, the operating principle, and discusses the instrument's probes and output connections.
Wayne Kerr Corp. 6276

Transducers—A new, highly illustrated *Brochure No. 101160,* recently published, shows a full line of Kistler natural quartz crystal transducers for pressure, force, acceleration, and vibration measurements.
Kistler Instrument Corp. 6277

Electronic Equipment—A 6-page short-form *Catalog No. 60* describing a complete

(*Continued on page 108*)



New RAC unit yields demulsibility characteristics of lubricating oils

Utilizing the Wheeling Steel Test Method, this compact new RAC Demulsibility Bath accurately determines the three important factors in establishing lubricating oil characteristics: percentage of water in the oil, total ml. of "free water," and ml. of emulsion separated from the mixture.

The all stainless steel bath is well insulated to prevent heat losses, offers two continuous duty stirrers for even heat distribution and Hevi-duty electrical heaters that provide temperature range from 50° to 250°F. Available in six, four and two-sample units, bath has inside dimensions of 36" X 12" X 18" and is equipped with a variable speed emulsifier with maximum of 8000 RPM. Unit can be easily converted to a regular water bath for other test work. Write for FREE bulletin giving specifications and prices.

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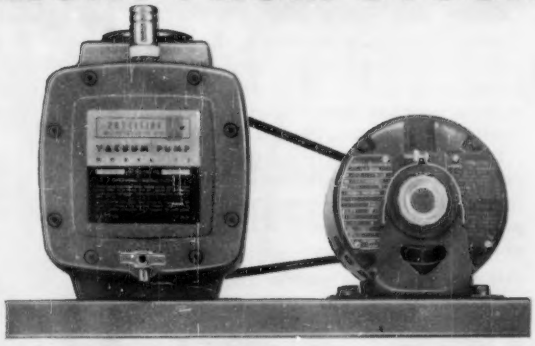

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CATALOGS & LITERATURE

(*Continued from page 107*)

line of electronic instruments has been published.
Krohn-Hite Corp. 6278

U.V. and I.R. Transmittance—The maximum ultraviolet and infrared transmittance of 26 MC & B spectroquality solvents is shown on a new 14- by 17-in. wall chart, recently published. The chart is available without charge.
Matheson Coleman & Bell 6279

Oscillograph Booklet—A new 36-page manual that illustrates the versatility of the direct-reading Visicorder oscillograph is available. Designed as a reference guide for engineers and scientists, the booklet contains 18 case history descriptions of how Visicorders have been used in widely different ways.
Minneapolis-Honeywell Regulator Co. 6280

Radioactive Compounds—A new radiochemical catalog, *Schedule F*, is available. The catalog lists over 400 radiolabeled compounds, including dozens of new items, many of which are available in AEC license-exempt quantities.
Nuclear-Chicago Corp. 6281

Atomic Counter—New 16-page bulletin shows the PC-3A system for precise proportional counting of alpha and beta activity in prepared samples.
Nuclear Measurements Corp. 6282

Thermometer Reading Lens—A convenient clip-on magnifier for reading laboratory thermometers, burets, and other liquid-level devices is described in a new *Bulletin No. 3000*.
Parr Instrument Co. 6283

Fluoroscopy—A new 4-page folder, *Electronic Fluoroscopy and High Speed Motion Picture Photography Used in the Evaluation of Sealed Assemblies*, describes how units under test can be evaluated during functional conditions such as simulated high-frequency vibration.
Philips Electronic Instruments 6284

Instrumentation Tape Recorders—New 2-color catalog sheet, *Bulletin No. 58*, describes the recently introduced 16-channel digital magnetic tape recorder, Model PS-216-D. Includes specifications, illustrations.
Precision Instrument Co. 6285

Relay Catalog—A complete catalog of relays is now available. Over 20 leading relay manufacturers' lines are listed with complete description and prices. A new thumb-indexed table of contents speeds the finding of relay desired.
Relay Sales, Inc. 6286

Gas Chromatography—The 600 Series of modular instruments for gas chromatography is illustrated and described in this first complete catalog of the modular units. The fully indexed 69-page catalog presents 22 modules and 21 other units and accessories.
Research Specialties Co. 6287

Quality Control—A 24-page booklet, Quality Control and Research, is now available.
Scientific Apparatus Makers Assn. 6288

Sand Equivalent Test—A new 4-page bulletin describing the sand equivalent test method is available.
Soiltest, Inc. 6289

INSTRUMENT COMPANY NEWS

Radionics, Inc., Norristown, Pa.—was recently organized to operate in the field of industrial applications of nuclear radiation. The new company has for its nucleus Radiation Engineered Services of Norristown, Pa., producers of industrial gamma radiography sources and equipment. Radionics will continue to market the gamma radiography line, and, later this year, will introduce a complete line of isotope thickness-density gages and gamma probing equipment for flaw detection in very thick sections of heavy materials.

LABORATORY NEWS

Caloric Appliance Corp., Jenkintown, Pa.—now has a new research and development center occupied and in full operation. The center includes an engineering department, testing laboratory, product styling department, and engineering offices.

MATERIALS NEWS

Steel for Reactor Use—Carpenter stainless type 304 with boron is similar to conventional type 304 with the addition of boron to give it a much higher thermal neutron absorption cross-section than other austenitic stainless steels. This alloy is available in several boron levels—2.00 per cent boron minimum, as well as lower levels of boron as specified by customer requirements. It is currently being used as control rods, burnable poison, and shielding for nuclear reactors. As the boron content increases, the tensile and yield strength increase and the ductility, impact strength, and corrosion resistance decrease. If a combination of high neutron absorption and high ductility is required, the isotope boron-10 may be used as the additive. The absorption cross-section of Carpenter type 304 with about 0.2 per cent boron-10 is approximately the same as type 304 with about 2.0 per cent natural boron.
The Carpenter Steel Co., Reading, Pa.

Epoxy-Glass Rolled Tubing—Known as Dilecto GB-125EFR, this rolled tubing is made from epoxy-resin impregnated glass cloth that is rolled and cured on mandrels. The new tubing grade is designed for use in transformers and other heavy electrical equipment and in military electronic equipment. In such use, it features excellent physical properties, flame retardance, arc resistance, and high flexural strength at 150 C and meets physical property requirements of NEMA G-11.
Continental-Diamond Fibre Corp., Newark, Del.

Silicones—A review of engineering properties of silicone products ranging from adhesives to release agents, laminating resins to rubber compounds, and electrical insulation to water repellents is available. The table of contents is arranged according to applications enabling quick, easy reference to silicone materials that resist the effects of time, heat, moisture, weathering, oxidation, and chemical attack. Extensively illustrated with photographs, tables, and graphs.
Dow Corning Corp., Midland, Mich.

(*Continued on next page*)

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Give quick accurate answers to the deteriorating effect of sunlight, weathering, washing and wearing of materials. A few minutes, hours, or days in Atlas-Ometers equals years of normal use deterioration.

Indispensable for speed testing in product development and quality control in production. Exact standardized test programs can be repeated as frequently as required.

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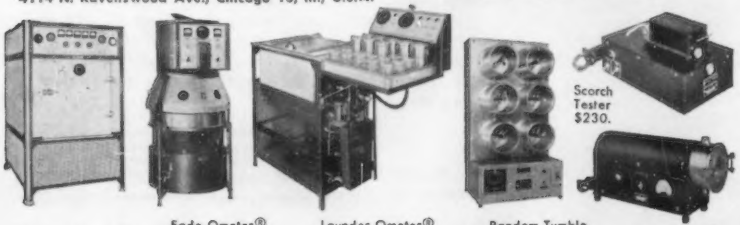
Weather testing translucent fiberglas for outdoor use in an Atlas Weather-Ometer at the Alsynite Company of America.



Weather-Ometer® $2755 up. Fade-Ometer® $1350 up. Complete with supplies. Launder-Ometer® $875 complete with accessories and supplies. Random Tumble Pilling Tester $485 to $890. Scorch Tester $230. Accelerator® $485.

FOR FURTHER INFORMATION CIRCLE 695 ON READER SERVICE CARD

Sigma Phase Role in Stainless—An 8-page booklet on sigma phase in austenitic stainless steels discusses its nature and occurrence, its chemical composition, its identification, its effect on mechanically stressed parts and corrosion rate, as well as its use in special applications. Copies of this booklet, number 8 in a series of "Alloy Notebooks" are available free of charge.

Electric Steel Foundry Co., Portland, Ore.

Silicone Fluid—A new electrical grade silicone fluid combining excellent electrical properties with an extremely low-temperature pour point, is now available. Identified as SF-85 (50), it is designed primarily as a dielectric fluid; however, it may be used as a special lubricant, heat-transfer medium, or a mechanical fluid, in a diversity of applications. The low-temperature pour point of SF-85 (50), below −120 F as determined by ASTM Method D 97, makes it especially suitable as a dielectric in extremely low-temperature applications. The viscosity of this fluid is 50 centistokes at 25 C (77 F), and it undergoes a smaller viscosity change at temperature extremes than conventional silicone fluids. As a result, SF-85 (50) offers application possibilities for airborne equipment subjected to both high and low temperatures.

General Electric Co., Waterford, N. Y.

Vermiculite—Facts about the new water-repellent vermiculite fill for insulating masonry walls in homes and commercial buildings are presented in a folder by Vermiculite Inst. The rigorous water-permeability and heat-transfer tests given the fill are outlined. Comprehensive tables of heat transmission coefficients are shown for cavity walls of brick, tile or stone; for backup walls with different facings; and for concrete block walls built with various block sizes. Also included are a coverage table and a short-form specification.

Vermiculite Institute, Chicago, Ill.

BOOKSHELF

(*Continued from page 101*)

Nuclear Science Series, National Academy of Sciences—National Research Council

The Radiochemistry of Cadmium, NAS-NS 3001, by James R. DeVoe, 57 pp., 75 cents.
The Radiochemistry of Arsenic, NAS-NS 3002, by Harold C. Beard, 27 pp., 50 cents.
The Radiochemistry of Francium, NAS-NS 3003, by Earl K. Hyde, 34 pp., 50 cents.
The Radiochemistry of Thorium, NAS-NS 3004, by Earl K. Hyde, 70 pp., 75 cents.
The Radiochemistry of Fluorine, Chlorine, Bromine, and Iodine, NAS-NS 3005, by Jacob Kleinberg and G. A. Cowan, 42 pp., 50 cents.
The Radiochemistry of Americium and Curium, NAS-NS 3006, by R. A. Penneman and T. K. Keenan, 62 pp., 75 cents.
The Radiochemistry of Chromium, NAS-NS 3007, by J. Pijck, 34 pp., 50 cents.
The Radiochemistry of Rhodium, NAS-NS 3008, by G. R. Choppin, 32 pp., 50 cents.
The Radiochemistry of Molybdenum, NAS-NS 3009, by E. M. Scadden and N. E. Ballou, 38 pp., 50 cents.

Adapted from publisher's description.

THESE PUBLICATIONS are six of a series of monographs on the radiochemistry of the elements being sponsored by the Subcommittee on Radiochemistry of the Committee on Nuclear Science of the United States National Academy of Sciences–National Research Council. In each is included a review of the nuclear and chemical features of particular interest to the radiochemist, a discussion of problems of dissolutions of a sample, counting techniques, and finally a collection of radiochemical procedures for the elements as found in the literature.

It is expected that about 50 of these monographs will be issued within the next four to six months. The publications are available from the Office of Technical Services, Department of Commerce, Washington 25, D. C., at the prices indicated.

Tin and Its Alloys

Edited by E. S. Hedges; Edward Arnold Ltd., London; distributed in U.S.A. by St. Martin's Press, New York, N. Y. (1960); 432 pp.; $27.50

Reviewed by J. W. Caum, ASTM Staff.

E. S. HEDGES, the editor of this book, is director, International Tin Research Council, and director, Tin Research Inst. The other contributors include three assistant directors and the chief metallurgist of the Tin Research Inst. The combined experience of all five contributors covers the entire field of tin technology.

(*Continued on page 110*)

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Continued from page 109)

Throughout the text a mere recording of facts has been avoided. Instead, a critical discussion of the subject matter is presented. References are kept to a minimum, with the information given rather than referenced. However, references are listed at the end of most chapters.

After a general introduction in Chapter I, the second chapter is devoted to tin itself, whether as pewter, foil, collapsible tubes, organ pipe, or tombs. Tin is relatively little used as a material of construction, so opportunity was taken for early display of its versatility. There follows in the third chapter a scientific account of the physical and mechanical properties of tin, and this is followed by a chapter on its chemical behavior. Chapter V continues the chemical theme by dealing with the electrodeposition of tin and its alloys, and chemistry is by no means absent in the treatment of the two following chapters on hot-tinning and on tinplate. Here, however, practical metallurgy has already reared its head and it prevails throughout the remaining chapters, which are devoted to applications of tin in the alloy field, mainly in bearing alloys, die-casting alloys, type metals, solders, and bronzes. In all this the authors and the editor have tried to keep a useful balance of theory and practice.

Much information about tin has been left out. The book confines itself to tin and its alloys mainly from the point of view of their properties and applications. The mining, extraction, and refining of tin are not treated, and the chemical compounds of tin are hardly mentioned. Chemical analysis does not fall within the scope of the book. Testing procedures are not treated as an entity, but are described in the relevant chapters. Corrosion is treated fairly extensively in Chapter IV and occasionally elsewhere.

Semiconductor Abstracts, Vol V—1957 Issue

Edited by C. S. Peet; John Wiley & Sons, Inc., New York, N. Y. (1960); 449 pp.; $12.

Adapted from publisher's description.

THESE ANNUAL abstracts of literature on semiconducting and luminescent materials and their applications are compiled by the Staff of the Battelle Memorial Institute, and the project is sponsored by the Electrochemical Society. In this issue of the annual abstracts, the coverage is more sharply focused on that portion of solid-state literature relevant to semiconductor interests than in earlier issues of the abstracts. This trend will continue in subsequent issues. Also in this volume, the index is improved and there is greater cross-referencing than heretofore. Altogether, there are 1705 abstracts in the present volume.

Properties of High-Temperature Ceramics and Cermets—Elasticity and Density at Room Temperature

S. M. Lang; National Bureau of Standards Monograph No. 6 (March 1, 1960); 45 pp.; 20 cents. (Order from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

Adapted from publisher's description.

RECENT advances in jet, rocket, and atomic-powered heat engines have stimulated an accompanying development in high-temperature ceramic and cermet materials which can withstand the high temperatures and corrosive atmospheres in these environments. Designers have been handicapped by a lack of data for the high-temperature ceramics, and, in addition, the available data have not always been consistent.

In order to supply reliable engineering data on this new class of materials, the National Bureau of Standards has assembled a stock of ceramic and cermet materials. This stock contains samples from leading manufacturers as well as many samples fabricated at the Bureau. The properties to be investigated include mechanical strength, elastic and anelastic characteristics, temperature dependence of these properties, and thermal properties in general.

This first report presents the results of an investigation: (1)' to determine the room-temperature elastic properties

(Continued on page 111)

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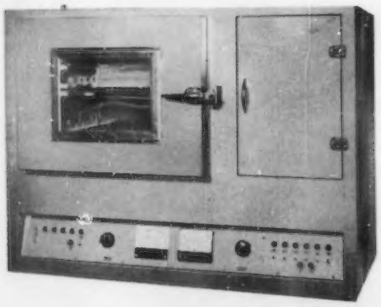

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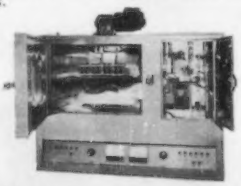

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(*Continued from page 110*)

by a dynamic (sonic) method; (2) to determine both the bulk and theoretical densities; (3) to evaluate from a statistical treatment of the data the variability of fabrication of the materials, using the elastic and bulk density data; and (4) to compare measurements of the elastic properties and densities for their usefulness as indicators of significant variations in fabrication.

Metal Curtain Wall Manual

Metal Curtain Wall Division, National Association of Architectural Metal Mfgrs.; Chicago, Ill.; $5.

Reviewed by L. C. Gilbert, ASTM Staff.

THE GROWTH of metal curtain wall construction since 1950 has been explosive. Few building concepts have enjoyed more rapid acceptance. As often happens in a rapidly growing industry, no organized body of technical information has existed to guide the efforts of designers and manufacturers. This lack has intensified, the problems of designing, fabricating, and erecting metal curtain walls to meet specific performance standards.

Recognizing the seriousness of the problem, a number of leading architectural metal manufacturers decided to undertake the development of an organized body of technical information. To accomplish this task, a Metal Curtain Wall Division was organized in June, 1957, as part of the already well established National Association of Architectural Metal Manufacturers. The *Metal Curtain Wall Manual* has been published by the Division.

The principal purpose of the manual is to provide the architect with a file of useful and reliable technical information on metal curtain wall design and performance. Included in it are sections on terminology, bibliography, general specifications, performance standards, design criteria, materials and finish standards, and testing procedures. The section on general specifications is intended as a guide to the architect in writing his specifications for a particular metal curtain wall. Proper use of these specifications in conjunction with the reference standards should ensure that the manufacturer will understand the design requirements and will be able to fabricate and erect the specified wall. Much of the confusion that existed in the past should thereby be eliminated. These specifications and standards represent, in the opinion of the manufacturers, the best current practice in curtain wall construction.

The manual has been prepared in looseleaf form so that it can be regularly revised and kept up to date. The present manual is far from complete. It is being released in its partially completed form, since it is felt that the information now prepared will be of real value to architects.

A NEW TENSILE TESTER FOR WIRE TERMINALS

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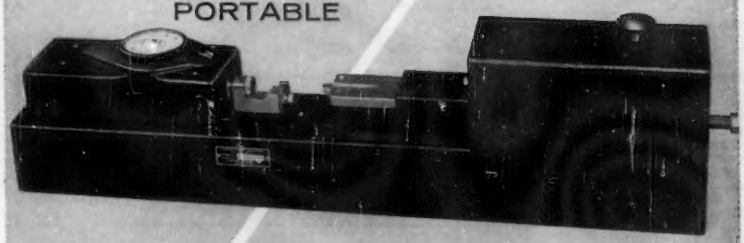

THE HUNTER MODEL "TT" TERMINAL PULL TESTER

The Hunter Model "TT" Tester is ideal for testing wire cable assemblies under MIL-T-7928 (ASG).

To expedite receipt of detailed literature on the Model "TT", write direct to Quality Control Department.

The "TT" Tester—latest addition to Hunter's growing line of quality control equipment—brings laboratory accuracy to production-line testing (±0.5% of full-scale reading). Though you'll find it adaptable to many other tensile tests in ranges up to 0-500 pounds, its special job is checking the secureness of solderless terminals crimped on wire. Automatically opening and closing jaws grip the wire sample; a turret-type gage head indexes quickly to hold any size terminal; load is applied at a preset rate by an adjustable air cylinder; and breaking load registers and is held on a direct-reading dial until reset by a touch of the quick-reset tab. Over-all speed of testing is up to ten times faster than by conventional methods.

Whether you attach terminals in your plant, or are supplied with wire assemblies—whether you use it in the plant or the laboratory—the "TT" Tester will help you establish useful standards and control quality by sample testing.

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Federal Government Standards Index Changes

THE FEDERAL Supply Service of the General Services Administration is charged with the responsibility for establishing specifications to be used by the Federal Government for Procurement of materials and supplies. The GSA issues an annual Index of Initiation of Federal Specifications Projects, and monthly supplements.

The items listed below appeared in Supplement 1 for March and Supplement 2 for April, 1960.

INITIATIONS

Title	Type of Action	Symbol or Number	FSC Class	Assigned Agency & Preparing Activity
Supplement 1, March, 1960				
Marking, Identification of Copper and Copper Base Alloy Mill Products	New	Fed. Std. No. 185	9630	DOD-Army-Ord
Tolerances for Steel and Iron Wrought Products	Chg. Not. 2	Fed. Std. No. 58	...	DOD-Navy-Ships
Artificial Leather, Cloth, Coated Vinyl Resin (Upholstery)	Int. Am. 1	CCC-A-700b	8305	GSA-FSS
Bolts, Plow, Hangar, T-Head, and Threaded Studs	New	FF-B-580	5306	COM-NBS
Bolts, Self-Locking, Steel	New	FF-B-	5305	DOD-Army-Ord
Chamois Leather, Sheepskin, Oil-Tanned	Int. Am. 1	KK-C-300a	8330	GSA-FSS
Cleaning Compound, Toilet Bowl	Rev.	O-C-426d O-C-00426e	7930	GSA-FSS
Cloth, Cotton, Chambray	Am. 1	CCC-C-231c	8305	DOD-Army-QMC
Cloth, Cotton, Corduroy	Am. 1	CCC-C-441	8305	DOD-Army-QMC
Cloth, Nylon Bunting and Cloth, Nylon, and Wool Bunting	Am. 1	CCC-C-476b	8305	DOD-Army-QMC
Dyeing and Aftertreating Processes for Cotton Fabrics	Am. 1	CCC-D-950	8305	DOD-Army-QMC
Gloves, (Leather, Gauntlet, Lineman's)	New	KK-G-476b	84	GSA-FSS
Gloves, Rubber, Synthetic	Am. 1	ZZ-G-381	8415	DOD-Navy-Ships
Leather, Sheepskin, Deerskin, Chamois Type	New	KK-L-256	8330	COM-NBS
Magnesite, Refractory, Coil Patching	New	SS-M-	9350	GSA-FSS
Molding Plastic, Cellulose Acetate	Am. 2	L-M-505	9330	DOD-Navy-Ships
Molding Plastic, Polystyrene	Am. 3	L-M-520	9330	DOD-Navy-Ships
Molding Plastic, Polystyrene, Modified	Am. 4	L-M-525	9330	DOD-Navy-Ships
Molding Plastic, Polyvinyl Chloride, Rigid	Am. 3	L-M-530	9330	DOD-Navy-Ships
Nut, Plain, Wing	Rev.	FF-N-845	5310	DOD-Navy-Ord
Packing, Fiber (Animal or Plant), Sheet	Rev.	HH-P-0096e	5330	DOD-Navy-Ships
Packing Material, Wick, (Candlewick), Cotton, Round	New	HH-P-	5330	GSA-FSS
Paint, Red-Lead-Base, Ready Mixed	Rev.	TT-P-86c TT-P-0086b	8010	GSA-FSS
Phosphor Bronze Bars, Plates, Rods, Sheet, Strips, Flat Wire, and Structural and Special Shaped Sections	Rev.	QQ-P-330a	9540	DOD-Navy-Ships
Pipe, Pressure Reinforced Concrete Coated Steel Pipe (Cement Mortar Lined)	New	SS-P-385	4710	INT-BR
Primer, Paint, Zinc-Chromate, Alkyd Type	New	TT-P-645	8010	DOD-Navy-Ships
Roofing, Asphalt Prepared, Mineral-Surfaced	New	SS-R-515	5650	DOD-Navy-Docks
Scouring Powder, Glass Cleaning	New	P-S-320a P-S-00320	7930	GSA-FSS
Screws, Cap, Socket Head	Rev.	FF-S-86a	5305	DOD-Army-Ord
Screws, Instrument, National Miniature (NM)	New	FF-S-	5305	DOD-USAF
Soap, Laundry (Powdered)	Rev.	P-S-598c	7930	DOD-Army-QMC
Sodium Hydroxide, Technical	New	O-S-598	...	DOD-Army-CE
Sweeping Compound, Absorbent Material, Oil and Water	m. 4	P-S-865	7930	GSA-FSS
Tape, Electric Wire, Flexible Insulating Sleeving Marking Machine (Foil Wire Identification, Marking)	m. 1	QQ-T-25	9535	GSA-FSS
Tape, Rubber (Natural, and Synthetic), Insulating	Rev.	HH-T-111e	5970	COM-NBS
Wire, Electrical and Nonelectrical, Copper	New	QQ-W-343	6145	DOD-Navy-Ships
Wood Preservative, Ammoniacal Copper-Arsenite Mixture	Rev.	TT-W-549c TT-W-00549b	8030	GR-FS
Wood Preservative, Chromated Copper Arsenate Mixture	Rev.	TT-W-550b TT-W-00550a	8030	GR-FS
Wood Preservative, Chromated Zinc Arsenate Mixture	Rev.	TT-W-538b TT-W-00538a	8030	GR-FS
Wood Preservative, Copperized Zinc Chloride Mixture	Rev.	TT-W-562b TT-W-00562a	8030	GR-FS

(Continued on page 114)

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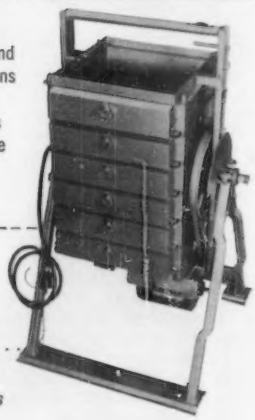

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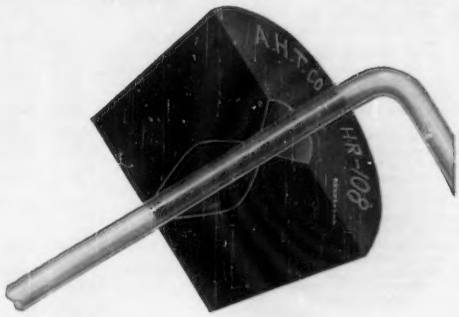

THOMAS HR-108 SAFETY STOPPERS are of bloomless, black, resilient, heat resisting composition, with low sulfur content and long life; specific gravity 1.08. Straight bore of the conventional stopper has been replaced by a fusiform bore with bevelled entrance. Internal diameter at center is approximately twice that of a 2 mm high sealing band at either end. These stoppers offer the following advantages:

Safety

Glass tubes can be easily inserted and removed, *particularly by students*, with greater safety than with straight bore. Insertion is facilitated by the bevelled entrance of the bore, and the tube slides through only the two sealing bands.

Larger Tubes

Fusiform bore permits insertion of larger tubes than is possible with straight bore. For example, tubes 6 to 11 mm can be inserted in sizes 5 to 9 incl.

Superior Composition

The stock contains *more than 70% of pure virgin gum*, possesses great elasticity, is free from surface sulfur and contains less than 0.75% free sulfur; no reclaimed rubber is used.

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Temperatures *up to 110°C* do not affect shape, size or structure.

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Tests indicate useful life approximately *five times* that of common stoppers.

HR-108 Safety Stoppers are not sold by weight but, because of the specific gravity and design, include more stoppers per pound than many other brands. They are packed in cartons, each containing approximately 1 lb. of a size, for convenient shelf storage. Each size is priced individually, based on actual cost of manufacture.

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FEDERAL GOVERNMENT STANDARDS INDEX CHANGES

(Continued from page 112)

Wood Preservative, Chromated Zinc Chloride Mixture	Rev.	TT-W-551d TT-W-00551c	8030	GR-FS
Zinc Coating, Electrodeposited, Requirements for	Am. 1	QQ-Z-325a	...	GSA-FSS
Supplement 2, April 1960				
Acoustical Units, Prefabricated	New	SS-A-00118c	5640	GSA-FSS
Beakers, Laboratory, Glass	Rev.	DD-B-136a	6640	DOD-Army-CmlC
Blankets, Bed, Other Than All Wool	Am. 1	DDD-B-421d	7210	DOD-Army-QMC
Borers, Cork	Rev.	GG-B-591b GG-B-00591a	6640	GSA-FSS
Cable, Power, Electrical and Wire, Electrical (Rubber Insulated, Building Type)	Rev.	J-C-103b	6145	COM-NBS
Cloth, Cotton, Birdseye and Gauze	Rev.	CCC-C-425a	8305	DOD-Army-QMC
Cloth, Cotton, Buckram	Rev.	CCC-C-438a	8305	DOD-Army-QMC
Cloth, Cotton, Flannel	New	CCC-C-458	8305	DOD-Army-QMC
Crucibles and Covers, Porcelain	Rev.	DD-C-686b	6640	DOD-Army-CmlC
Dishes, Culture, Petri (Glass)	Rev.	DD-D-411c	6640	DOD-Navy-MMSA
Dishes, Evaporating	Rev.	DD-D-420a	6640	DOD-Army-CmlC
Dishes, Evaporating, Platinum, 100ml.	Rev.	GG-D-406b	6640	DOD-Army-CmlC
Ethylene Glycol Monoethyl Ether (for use in Organic Coating)	Rev.	TT-E-781b TT-E-00781a	8010	GSA-FSS
Glass Cleaner, Liquid	Am. 2	P-G-406b	7930	GSA-FSS
Graduates, Glass, Corrosion-Resistant Steel, and Porcelain-Enameled (for Photographic Use)	Rev.	GG-G-631a	6640	DOD-Army-CmlC
Graduates, Glass, Pharmaceutical and Commercial	Rev.	DD-G-666b	6640	DOD-Army-CmlC

TITLE CHANGES

Title	Type of Action	Symbol or Number	Former Title
Supplement 1, March, 1960			
Wire, Electrical and Nonelectrical, Copper	New	QQ-W-343	Wire, Copper, Bare
Supplement 2, April, 1960			
Cable, Power, Electrical and Wire, Electrical (Rubber Insulated, Building Type)	Rev.	J-C-103b	Cable and Wire, Rubber Insulated, Building Type

WITHDRAWALS

	Type of Action	Symbol or Number	Assigned Agency or Technical Committee	
Supplement 1, March, 1960				
Cloth, Cotton Corduroy	Rev.	CCC-C-441a	DOD-Army-QMC	To be replaced with amendment to CCC-C-441.
Soap, Laundry (Powdered)	Am. 2	P-S-596c	DOD-Navy-Ships	Project has been converted to revision
Supplement 2, April, 1960				
Crucibles and Covers, Porcelain	Rev.	DD-C-686b	DOD-Army-CmlC	A proposed rev. will be prepared in lieu of Int. Fed. Spec. DD-C-00686b (HEW-PHS).

PROMULGATIONS

Title	Type of Action	Symbo Number
Supplement 1, March, 1960		
Artificial Leather, Cloth, Coated, Vinyl Resin, (Upholstery) (Superseding CCC-A-00700 (GSA-FSS) and CCC-A-700)	Rev.	CCC-A-700b
Bearing, Sleeve, (Bronze, Plain or Flanged)	New	FF-B-195
Box, Fiberboard (Superseding PPP-B-00636a and PPP-B-636)	Rev.	PPP-B-636b
Enamel, Alkyd, Gloss, (for Exterior and Interior Surfaces) (Superseding TT-E-489b)	Rev.	TT-E-489c
Enamel, Odorless, Alkyd, Interior, High Gloss, White and Light Tints (Superseding TT-E-00505 (Army-CE))	New	TT-E-505a
Feathers, Waterfowl and Down, Waterfowl	Am. 1	O-F-160a
Pipe, Bituminized Fiber, (Perforated Drainage) and Fittings for Same (Superseding SS-P-00358(COM-BPR))	New	SS-P-358a
Tape, Pressure-Sensitive Adhesive Paper, Water Resistant, (for Carton Sealing) (Superseding PPP-T-76)	Rev.	PPP-T-76a
Washer, Pipette, Automatic (Superseding GG-W-00105b (HEW-PHS) and GG-W-105a)	Rev.	GG-W-105c
Wire, Steel, Carbon, (for Cold Heading and Cold Forging) (Superseding QQ-W-00409(GSA-FSS) and QQ-W-409)	Rev.	QQ-W-409a
Supplement 2, April, 1960		
Aluminum Alloy Ingot (for Remelting) (Superseding QQ-A-371c)	Rev.	QQ-A-371d
Brazing Alloy, Copper, Copper-Zinc, and Copper-Phosphorus (Superseding QQ-B-650 and QQ-B-00655a (Army-Ord) (in Part))	Rev.	QQ-B-650a

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CIRCLE 704 ON READER SERVICE CARD

Brazing Alloy, Gold (Superseding QQ-B-653a)	Rev.	QQ-B-653b
Ethyl Alcohol (Ethanol), Denatured Alcohol, and Proprietary Solvent	Am. 2	O-E-760b
Glass Cleaner, Liquid	Am. 2	P-G-406b
Molding Plastic, Polystyrene, Modified	Am. 3	L-M-525
Paint, Varnish, Lacquer, and Related Materials; Packaging, Packing, and Marking of (Superseding TT-P-143)	Rev.	TT-P-143a
Pigment, Mineral-Red (Iron-Oxide) Natural, Dry (Superseding TT-M-00381a(GSA-FSS) and TT-M-381)	New	TT-P-408
Steel Strapping, Flat (Superseding QQ-S-00781c (Navy-Ships) and QQ-S-781b)	Rev.	QQ-S-781d
Tape, Pressure-Sensitive Adhesive, Packaging and Packing of (Superseding PP-P-00680(GSA-FSS)	New	PPP-T-680

INTERIM FEDERAL SPECIFICATIONS ISSUED

Title	Type of Action	Symbol or Number
Supplement 1, March, 1960		
Aluminum Bronze Bars, Rods, Shapes, Drawn Strip, and Forgings	Am. 1	QQ-A-630(Navy-Ships)
Cleaning Compound, Toilet Bowl	New	O-C-00426e(GSA-FSS)
Cleaning Solution, Porcelain	Am. 1	P-C-00450a(GSA-FSS)
Cloth, Thread, and Tape-Asbestos	New	SS-C-00466b(Navy-Ships)
Cushion (Underlay), Carpet and Rug, Sponge and Latex Foam Rubber	New	ZZ-C-00811a(COM-NBS)
Cushioning Material, Cellulosic	Am. 3	PPP-C-843(GSA-FSS)
Fabric, Nonwoven	Am. 2	CCC-F-46(GSA-FSS)
Fabrics, Upholstery	Am. 2	CCC-F-66a(GSA-FSS)
Granules, Reflectorized	New	TT-G-00490(Navy-Weps)
Hose, Plastic, Garden	New	L-H-00520(GSA-FSS)
Kegs, Wood, Slack	New	NN-K-00231c(GSA-FSS)
Mail Bag, Distributing (Fiberboard)	Am. 1	LLL-M-63(GSA-FSS)
Paint, Reflectorized, for Airfield Runway Marking (Drop-in Type)	Am. 1	TT-P-0085(DOD)
Paper, Carbon, Typewriter, Black	New	UU-P-00158b(Army-QMC)
Paper, Gasket, Fiber (Animal or Plant), Sheet	New	HH-P-0096e(Navy-Ships)
Plastic Sheet, Scribe-Coated	New	L-P-00517a(DOD)
Plastic Sheet, Tracing, Glazed and Matte Finish	New	L-P-00519a(DOD)
Scouring Powder, Glass Cleaning	New	P-S-00320(CSA-FSS)
Steel, Plate, Carbon, Marine Boiler	Am. 1	QQ-S-691a(Navy-Ships)
Steel Plates, Shapes and Bars, Carbon, Structural	Am. 1	QQ-S-741a(Navy-Ships)
Steel Plates, Sheets and Strip, Corrosion Resisting	Am. 1	QQ-S-766c(Navy-Ships)
Wood Preservative, Chromated Zinc Arsenate Mixture	Rev.	TT-W-00538a(AGR-FS)
Wood Preservative, Ammoniacal Copper Arsenite Mixture	Rev.	TT-W-00549b(AGR-FS)
Wood Preservative, Chromated Copper Arsenate Mixture	Rev.	TT-W-00550a(AGR-FS)
Wood Preservative, Copperized Chromated Zinc Chloride Mixture	Rev.	TT-W-00562a(AGR-FS)
Wood Preservative, Treating Practices	Rev.	TT-W-00571e(AGR-FS)
Supplement 2, April, 1960		
Acoustical Units, Prefabricated	New	SS-A-00118c(GSA-FSS)
Ethylene Glycol Monoethyl Ether (for Use in Organic Coatings	New	TT-E-00781a(GSA-FSS)
Mattress, Bed, Latex Foam	New	ZZ-M-0091b(Army-QMC)
Paper, Book	Am. 1	UU-P-465c(GSA-FSS)
Polyethylene Film, Thin Gage	New	L-P-00373(Army-QMC)
Sealing Compound, Two-Component, Elastomeric, Polymer Type, Jet-Fuel-Resistant, Cold-Applied Concrete Paving	Rev.	SS-S-00200a(Army-CE
Wood Preservative, Acid Copper Chromate Mixture	New	TT-W-00564b(AGR-FS)
Wood Preservatives, Treating Practices	Rev.	TT-W-00571f(AGR-FS)

CANCELLATIONS

Title	Symbol or Number	Reason for Cancellation
Supplement 1, March, 1960		
Steel, Tool, Carbon and Carbon-Vanadium	QQ-S-00779(Army-Ord)	Canceled
Tar, Pine, Technical-Grade	JJJ-T-121	Superseded by LLL-P-430a
Ticking, Mattress and Pillow	CCC-T-351	" " CCC-C-436
Wire Rope and Wire Strand	RR-W-00410(Navy-Ships)	Canceled
Supplement 2, April, 1960		
Brazing Alloys	QQ-B-00655a	Superseded by QQ-B-655b
Joints, Standard-Taper, and Spherical, Ground	DD-J-00550(GSA-FSS)	" " DD-G-675
Stopcocks, Standard - Taper, Ground Glass	DD-S-00720(GSA-FSS)	" " DD-S-720a
Stoppers, Standard - Taper, Ground Glass	DD-S-00750(GSA-FSS)	" " DD-S-750a
Tile, Floor, Vinyl-Asbestos	L-T-00345(GSA-FSS)	Canceled

SPECIFICATIONS AND STANDARDS APPROVED FOR PRINTING

Title	Type of Action	Symbol or Number
Supplement 1, March, 1960		
Aluminum Alloy Ingot (for Remelting)	Rev.	QQ-A-371d
Brazing, Alloy, Copper, Copper-Zinc, and Copper-Phosphorus	Rev.	QQ-B-650a
Brazing Alloy, Gold	Rev.	QQ-B-653b
Enamel, Alkyd, Gloss (for Exterior and Interior Surfaces)	Rev.	TT-E-489c
Ethyl Alcohol (Ethanol), Denatured Alcohol, and Proprietary Solvent	Am. 2	O-E-760b
Glass Cleaner, Liquid	Am. 2	P-C-406b
Mineral-Red (Iron-Oxide), Natural, Dry (Paint-Pigments)	Canc.	TT-M-381
Molding Plastic, Polystyrene, Modified	Am. 3	L-M-525
Pigment, Mineral-Red (Iron-Oxide), Natural, Dry	New	TT-P-408
Pipe, Bituminized Fiber, (Perforated Drainage) and Fittings for Same	New	SS-P-358a
Supplement 2, April, 1960		
Butyl Alcohol, Normal (Butanol) (for use in Organic Coatings)	Rev.	TT-B-846b
Carpet, Loop, and Rug, Loop (Wool Pile, Knitted)	New	DDD-C-80a
Cork, Compressed (Corkboard) (for Thermal Insulation)	Canc.	HH-C-561b
Diamyl Phthalate, Plasticizer (for Use in Organic Coatings)	Rev.	TT-D-291b
Dibutyl Phthalate, Plasticizer (for Use in Organic Coatings)	Rev.	TT-D-301b
Drum, Metal Shipping, Steel (over 12 and under 55 gal.)	Am. 1	PPP-D-705a
Ethylene Glycol Monobutyl Ether (for Use in Organic Coatings)	Rev.	TT-E-776b
Filler, Wood, Paste	Am. 1	TT-F-336b
Ground Joint, Laboratory Glassware, Taper and Spherical	New	DD-G-675
Insulation Board, Thermal, Cork	New	HH-I-525
Linseed Oil, Boiled (for Use in Organic Coatings)	New	TT-L-190a
Linseed Oil, Raw (for Use in Organic Coatings)	New	TT-L-215a
Oil, Linseed, Boiled (for Use in Organic Coatings)	Canc.	TT-O-364
Oil, Linseed, Raw (for Use in Organic Coatings)	Canc.	TT-O-369
Orthophosphoric (Phosphoric) Acid, Technical	New	O-O-670
Paint, Varnish, Lacquer, and Related Materials, Packaging, Packing, and Marking of	Rev.	TT-P-143a
Paper, Book	Am. 2	UU-P-465c
Phosphoric Acid, Technical-Grade	Canc.	O-P-313
Stopcock, Laboratory Apparatus, Taper-Ground	New	DD-S-720a
Stopcocks, Stoppers, and Joint, Ground Glass, Standard-Taper	Canc.	DD-S-722a
Stopper, Laboratory Apparatus, Taper-Ground	New	DD-S-750a
Tape, Electric Wire—Flexible Insulating Sleeving Marking Machine, (Foil, Wire Identification, Marking)	Am. 1	QQ-T-25
Towels, Paper	Am. 1	UU-T-591d
Tube, Aluminum Alloy, Round, Square, Rectangular, and Other Shapes, Drawn, Seamless, 1100	Rev.	WW-T-783c
Tube, Aluminum Alloy, Round, Square, Rectangular, and Other Shapes, Drawn, Seamless, 2024	Rev.	WW-T-785c
Tube, Aluminum Alloy, Round, Square, Rectangular, and Other Shapes, Drawn, Seamless, 3003	Rev.	WW-T-788c
Tube, Aluminum Alloy, Round, Square, Rectangular, and Other Shapes, Drawn, Seamless, 5052	Rev.	WW-T-787b
Tube, Aluminum Alloy, Round, Square, Rectangular, and Other Shapes, Drawn, Seamless, 6061 and 6062	Rev.	WW-T-789b
Varnish, Asphalt	Rev.	TT-V-51c

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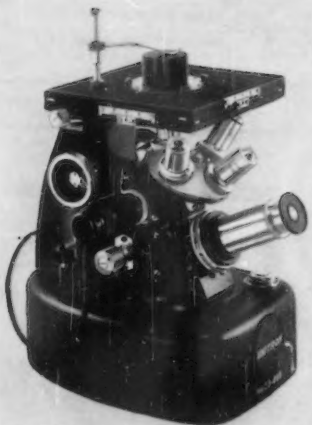
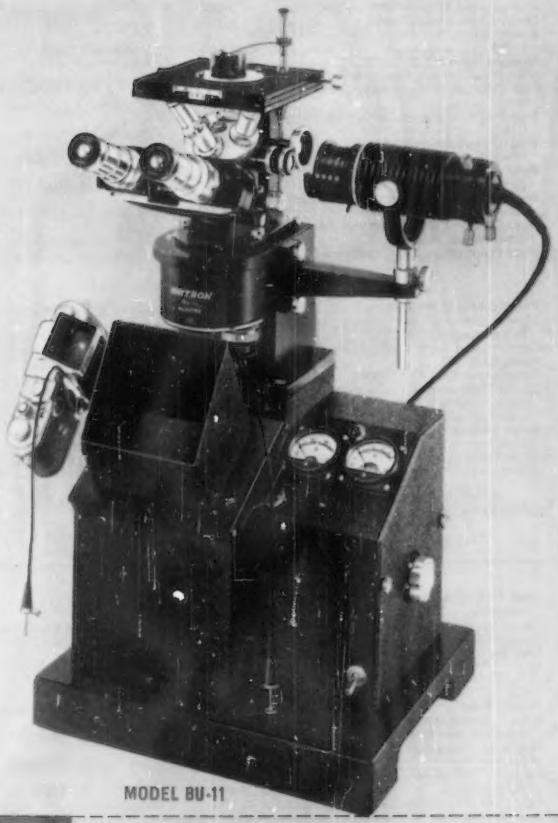


MODEL MEC

UNITRON INVERTED Metallurgical Microscope: This compact unit provides many of the features usually found only in larger metallographs. Standard equipment includes optics for 25–1500X, polarizers, filters, transformer in base, etc. A built-in camera attachment for 35mm. photography is included with the binocular and available for the monocular model. Extra accessories include Polaroid camera attachment, vacuum heating stage and illuminator for transmitted light. Think of the time which your laboratory can save by providing each metallurgist with one of these handy, inexpensive units for use at his desk.

Monocular Model MEC $399 Binocular Model BMEC $615



MODEL BU-11

UNITRON METALLOGRAPH and Universal Camera Microscope: A completely self-contained instrument of modern design for visual observation, photography, projection, and measurement of both opaque and transparent specimens; using bright field, dark field, or polarized illumination. Standard equipment includes all optics for 25–2000X, polarizers, filters, 3¼" x 4¼" camera, and many accessories. Also available are camera attachments for Polaroid, 35mm., and motion picture photography; vacuum heating stage for temperatures to 1500° C.; and macro-objectives (5–40X). Even laboratories on a limited budget can enjoy the precision, speed and efficiency possible only with a complete installation of this type.

Monocular Model U-11 $1195 Binocular Model BU-11 $1379

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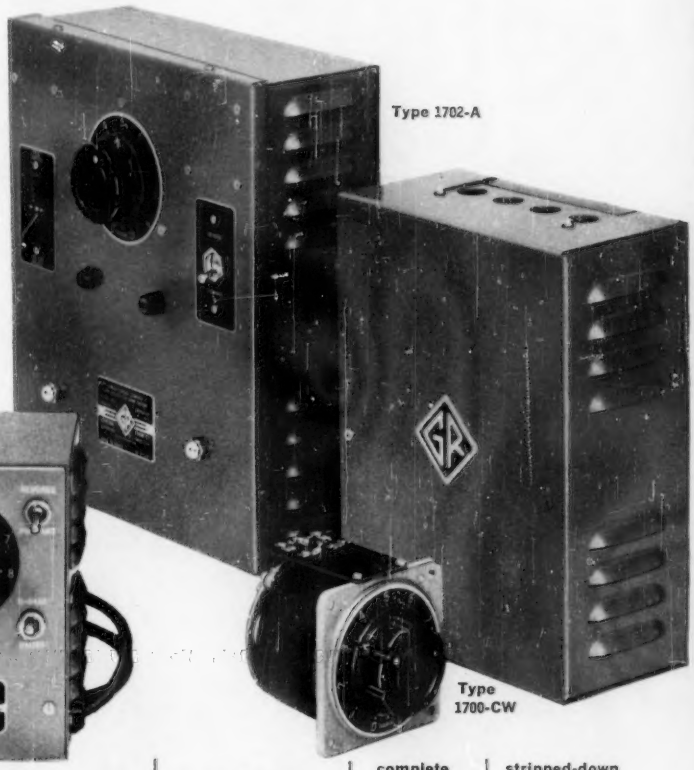

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for series or universal motors 1/15 hp or less	0 to rated	1701-AU $95	—
for shunt or compound motors 1/12 hp to 1/6 hp	0 to rated 0 to 1.25x rated 0 to 1.5x rated	1703-A $110	1703-BW $90
for shunt or compound motors 1/4 hp to 1/3 hp	0 to rated 0 to 1.15x rated	1700-B $180	1700-CW $155
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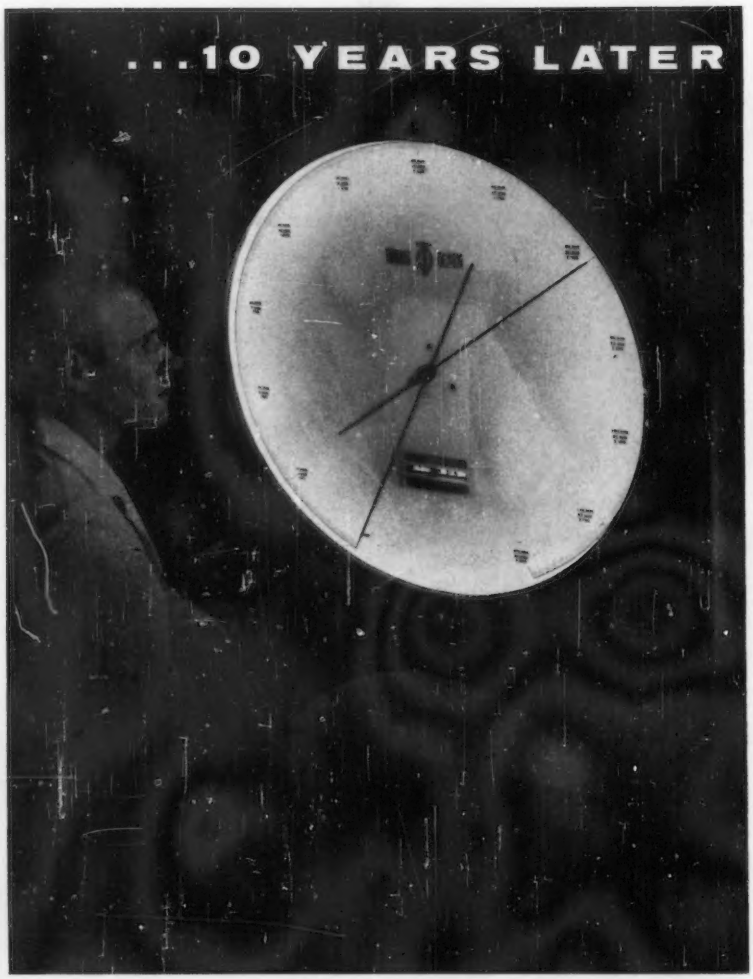

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